MALE SPHAEROPTHALMINE MUTILLID WASPS OF THE NEVADA TEST SITE[1]

by

William E. Ferguson[2]

INTRODUCTION

In 1959, ecological studies of the fauna at the Nevada Test Site were begun by Drs. Dorald M. Allred and D Elden Beck of the Department of Zoology and Entomology, Brigham Young University[3]. In 1962 I was asked to identify the mutillid wasps which had been taken in large numbers, chiefly from can pit-traps (Fig. 1) that

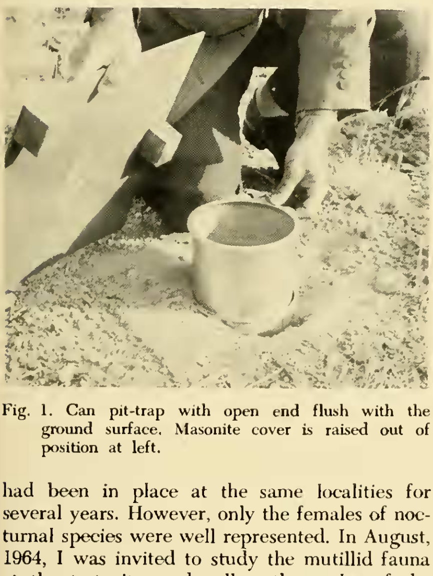

Fig. 1. Can pit-trap with open end flush with the ground surface. Masonite cover is raised out of position at left.

had been in place at the same localities for several years. However, only the females of nocturnal species were well represented. In August, 1964, I was invited to study the mutillid fauna at the test site, and collect the males of the species. The females remain largely unstudied, unnamed, and have been grouped as one genus, although the males are much better known and are separable into several genera. Only three published accounts of sex correlations among the nocturnal mutillids appear in the literature. It was assumed that with the large numbers of females at hand, the sexes of the species could be correlated in spite of the great sexual dimorphism.

Attempts to correlate the sexes at the test site were unsuccessful. Possible reasons are as follows: (1) The apterous females were collected between 1959 and 1962, but most of the males were taken only in August, 1964, under different ecological conditions and by different collection methods, even though attempts to collect them were made at other times of the year. (2) Cycles of abundance are known to change considerably over the years (Ferguson, 1962). (3) Light traps are highly selective for males, and attract them from large areas. (4) Can pit-traps are nonattractive to females and males, but since the females must travel on the ground, they are more liable to find the covered traps by chance, and fall into the cans. (5) Males can fly out of the cans, whereas the females cannot escape. (6) Males which fall into the cans are more likely to be eaten by lizards and arthropods also caught in the traps, since the male mutillids are more active, less heavily sclerotized, and in contrast to the females, cannot sting. The best method of associating the males and females at the test site apparently must involve a thorough study of females from areas outside of the test site. Through study of the distributional patterns of the females, it may be possible to correlate them with males by a process of elimination based on geographical occurrence. The large number of unnamed females must be described, and all named females must be redescribed. This will be a considerable task that may take several years, and naturally is not within the scope of the present study.

Although the diurnal mutillids in this study are rather well known, even the males of nocturnal species are poorly known taxonomically

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[2]Associate Professor of Eotomology, Department of Biological Sciences, San Jose State College, San Jose, California, 95114

[3]For a detailed discussion on the ecology of the test site, refer to Allred, Beck, and Jorgensen (1963a, 1963b).

and distributionally. This study not only makes known the sphaeropthalmine Mutillidae of the test site, but contributes importantly to our knowledge of the taxonomy and distribution of the nocturnal Mutillidae. Furthermore, it has shown that even the former "ground zeros" of nuclear detonations are reoccupied by the mutillids within a few years following a blast or series of blasts. The barren area surrounding ground zero apparently is attractive as a nesting site for various species of flying aculeate Hymenoptera, which become hosts of the parasitic mutillids. The host species may find food for provisioning their brood cells in the soil, either inside or outside of the barren area. The flightless female mutillids then have reinvaded the barren area in one or both of the following ways: (1) by walking from the undevastated perimeter back into the barren area, or (2) by surviving nuclear blasts while in nests of their hosts deep in the soil, and emerging into the devastated area after the blast. There is interest as to whether or not nuclear testing will cause genetic abnormalities that will result in deformation, "monsters," and other unusual genetic traits. A careful search was made for such anatomical changes among the Mutillidae collected at the test site. Apparently the Mutillidae are not anatomically different from those outside of the test site. An organism's genetic adjustment to its environment is like an accurately adjusted chronometer. Anything that happens to that adjustment will most likely be deleterious. Hence, one would expect that genetic changes in creatures of the harsh desert environment would prove fatal in an extremely high percentage of instances. Abnormalities (unfavorable genetic traits) should neither survive nor spread commonly throughout a normal, surrounding population. This appears to be true of the mutillid population samples, if such genetic aberrations have occurred.

ECOLOGY OF THE TEST SITE

The Nevada Test Site of the Atomic Energy Commission is located in southern Nye County, Nevada, at elevations from approximately 2800 ft, at Fortymile Wash, to 7694 ft on Rainier Mesa. The vegetation ranges from halophytes typical of the Mojave Desert playa margins, to the open stands of *Pinus monophylla* and *Artemisia tridentata* at higher elevations. The area is especially interesting because the boundary of the Mojave and Great Basin Deserts cuts in an east-west direction through the test site near its middle. More detailed discussions of the ecology of the test site were prepared by Allred, *et al.* (1963a, 1963b).

MATERIALS AND METHODS

Specimens from the test site were collected principally in sheltered can pit-traps in the soil (Fig. 1) and from light-traps of three kinds: (1) a 200-watt incandescent bulb suspended from a tripod above a ground-level, white cloth sheet; (2) a one- or two-mantle Coleman gasoline lantern above a white sheet or water-filled trap (Fig. 2); and (3) an ultraviolet light source (Fig. 3). Gasoline lanterns and ultraviolet lights appear to be equally effective in attracting mutillid wasps. The use of lights above sheets permitted hand-catching of the mutillids which were attracted to the lights. These were placed separately into cyanide killing jars, thus avoiding the disadvantage of moth scales and damage by other insects as is typical of most light traps. Specimens were returned to the laboratory and pinned before drying, and the genitalia were extruded.

Ultraviolet and incandescent light-traps were operated all or part of the night. Insects of many kinds were caught as they fell into detergent water beneath the light sources. The detergent used was American Cyanamid's Aerosol-OT. However, most other detergents were almost equally effective in reducing surface tension, thus permitting the insects to "drown" quickly, rather than struggle on the water surface. The insects apparently were immobilized by the greatly reduced oxygen supply in the water, but after submergence during the night, most of the insects became active again within a few minutes to several hours after removal from the water. The nocturnal mutillids were

Fig. 2. Gasoline lantern light-trap. A large aluminum salad-ring mold is buried with its edge flush with the ground surface, and is filled with detergent water. The lantern covers the center hole and provides light all night.

washed individually in clean detergent water, rinsed for a few minutes in 70% and 90% ethyl alcohol, dried briefly on a paper towel, and pinned. This procedure prevented matting of the pubescence and wings, especially when the pinned specimen was blown upon with a strong air stream from the lips. The unattended, all-night light-traps were especially effective for trapping the small, hard-to-catch individuals, for collecting a series of a common species, and for catching individuals of species which were present in low densities.

Although females are positively phototaxic at night, few were attracted into the light-traps. Probably this was due to ground-level shadows of surface irregularities and plants, and to low mobility of the females.

Can pit-traps were outstandingly effective in trapping female mutillids, but either were much less effective in trapping males, or allowed them to escape after entering the traps. Specimens from can pit-traps had been preserved in alcohol, which is unsuitable for mutillids. Furthermore, some of the vials lost alcohol through their cork stoppers, thus concentrating the glue-like dissolved body fluids and dirt. All alcoholic specimens required washing in 70% and 90% ethyl alcohol, and ether, prior to pinning and identification. Nevertheless, some could not be restored adequately for certain identification be-

Fig. 3. Generator-operated, 40-watt ultraviolet light-trap supported on folding wooden legs. The shallow depression beneath was formed with a shovel, lined with a plastic sheet, and filled with detergent water.

cause of altered integumental color, matted hairs and wings, and insoluble "glue" and dirt on the integument.

Each specimen was assigned a reference number and a code number, both of which relate to collection records.

Because of inadequate knowledge of female behavior, it is impossible at the present time to determine the influences of certain ecological factors on the two sexes. However, during the light-trapping in August, 1964, surface activity of the males was greatly reduced or even stopped by bright moonlight, rain, strong winds, or low temperature. Nocturnal temperatures in the range 80° to 100° F apparently are optimum for the flight of the males, but activity was noticeably reduced in the range of 70° to 80° F, and was insignificant below that temperature range.

Distribution records for the test site are fragmentary and are localized because of preplanned, intensive collections in selected areas, especially those closer to headquarters at Mercury, and adjacent to roads. More informative can pit-trap and light-trap survey data for the Mutillidae should include replicated transects between altitude extremes and in the same vegetation types at comparable sampling stations. All-night, gasoline lantern, detergent-water light-traps operated once or twice each week would catch males and some females, but permanently installed can pit-traps for females could be operated continuously at each station. Such a sampling method would provide much more trustworthy information on sex associations and relative abundance.

Specimens on which this study is based came primarily from Frenchman Flat and the hillsides north-northwest of Mercury. Locality 1B, in Yucca Flat, and Cane Springs were secondary collection sites, and collections from the higher valley slopes and top of Rainier Mesa were relatively few. Figure 4 will assist in locating the areas referred to in this paper. For more exact collection code interpretation, refer to Allred, *et al.* (1963b).

The light-trap collections of nocturnal male mutillids were limited at the test site, but several factors permit making generalizations about the distribution of species there. First, maximum and minimum temperatures, which were recorded for several years at a number of localities at the test site, indicate that August is the most favorable time for nocturnal activity of mutillids. Consequently, one can expect the largest numbers of individuals and species to be active during that month, when most of the light-trapping was done. Furthermore, I have collected extensively to the north of the test site in the Great Basin Desert, and to the south in the Sonoran Desert. Collections from these two deserts have been compared with each other, with smaller collections from the Mojave Desert, and with collections from the test site, as a basis for speculating or generalizing about the occurrence of mutillids at the test site. These speculations must not be confused by the reader with the presently known facts of distribution, which are simply the raw collection data.

HISTORICAL REVIEW

Prior to 1958, the classification of nocturnal Mutillidae and the description of species were based largely upon morphological characters which today are not recognized as reliable indicators of phylogenetic relationship. Schuster's important paper was published in 1958, but had been written approximately twelve years earlier. It included many new, very distinct species, focused attention on newly discovered taxonomic characters, and included a new classification. However, several characteristics of his work have impeded rapid improvement of our taxonomic concepts and classification of the nocturnal Mutillidae. These impediments include (1) validation of most specific names only in keys rather than in adequate descriptions, (2) lack of precise type locality or distribution data, (3) lack of information on the range of variability of each species, (4) lack of designated holotype specimens for many names, and (5) apparent

Key to the important collection localities shown in Fig. 4.

1. Mercury—incandescent and ultraviolet light collections
2. Hillside 0.8 mi NNW of Mercury—incandescent and ultraviolet light
3. 10S study area—can pit-traps
4. ½ mi E of Mercury Hwy. on Kay Bunker Rd.—light collections
5. Cane Springs—can pit-traps and light collections
6. 0.3 mi W of Y on Rainier Mesa—light collections
7. Rainier Mesa Rd. at ponds near Tunnel E—light colections
8. 1 mi W of Y on Rainier Mesa—light collections
9. 0.9 mi W of Area 12 residences—light collections
10. 3 mi SSW of Area 12 residences on new road to Fortymile Canyon—light collection
11. 1B study site—can pit-traps, one light collection at 1BB25
12. 0.2 mi E of Mercury Hwy. at Checkpoint Pass—light collection
13. Old Mercury Hwy., 1 mi from Mercury Hwy., at 3400 ft (extreme NE corner of Specter Range Quadrangle)—light collection
14. 5A study area—can pit-traps and light collections
15. Old Mercury Hwy. in barren, extensive sandy wash, 2 mi from intersection with Mercury Hwy. in Frenchman Flat—light collection
16. 5E study area—can pit-traps and light collections
17. 4A study area—can pit-traps
18. ECB study area—ultraviolet light collections
19. CP study area—Allred live-catch, box-type traps
20. 6A study area—can pit-traps
21. 1F study area—can pit-traps

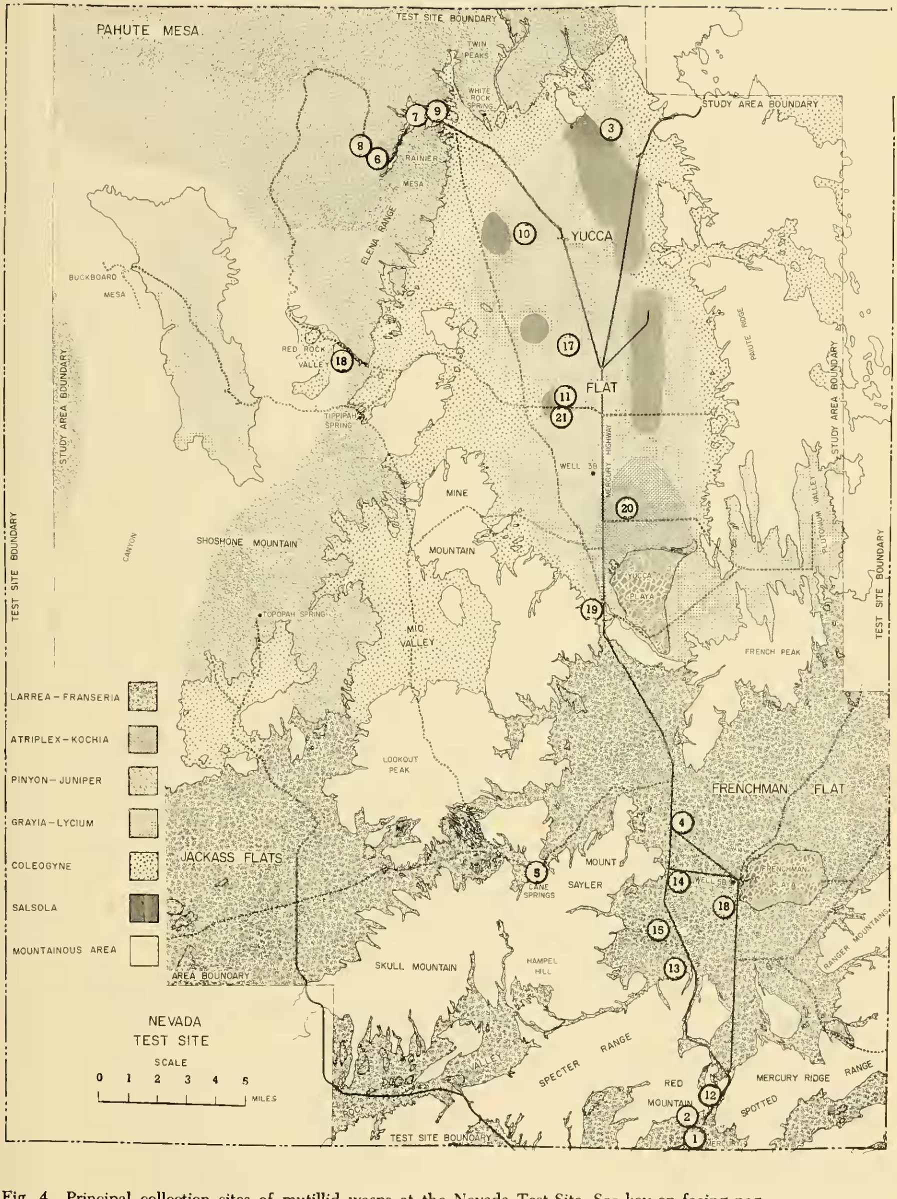

Fig. 4. Principal collection sites of mutillid wasps at the Nevada Test Site. See key on facing page.

loss of some holotypes and lack of information about locations of many others.

In July, 1959, one year after publication and approximately thirteen years after preparing the first manuscript, Schuster attempted to find and label type specimens representing the names that he had validated in his keys. Some were found and deposited in major repositories, some were not found, whereas others apparently remain in the Schuster collection although they are the property of institutions from which they were borrowed many years ago.

Because Schuster largely neglected publication of type data, it is included here, when known, for all species. Missing type specimens, inaccessibility of others, and unpublished type data have affected this study in several ways: (1) inability to verify the accuracy of some steps in Schuster's key leaves identification of a few species in question, (2) a few specimens from the test site have been retained by me without identification because they represent undescribed or inadequately described species, and type material is unavailable for comparison.

MORPHOLOGICAL CHARACTERS

Certain terminology and measurements used by Schuster have never been adequately explained; hence, I have included herein my interpretation of these, and an alteration of some other aspects of his terminology.

Measurements are most meaningful to mutillid taxonomists when expressed in units rather than in a ratio or other expression. The taxonomist must be able to judge the accuracy of measurement when necessary, and construct whatever ratios may be desirable from the unaltered measurements. Consequently, in descriptions of new species I have given most measurements in ocular micrometer units, which equal one-sixtieth of a millimeter. The limits of accuracy in using my ocular micrometer at 60x magnification are plus or minus one-half unit. Measurements on small individuals, therefore, are subject to relatively greater error.

Relative to pubescence, I have used the term **simple hair** to describe hairs which have smooth rather than barbed surfaces. **Brachyplumose** refers to hairs which have many barbs, the lengths of which are approximately equal to or less than the diameter of the hair at the place where each barb is located. **Plumose** is reserved for hairs which have longer barbs on at least part of their length.

Body size is variable and dependent on the amount of food available to the mutillid larva (Ferguson, 1962). **Sculpture** is most regularly and deeply expressed in large specimens, but becomes more irregular and less distinct among the smallest individuals of a species.

Directions of structures on the head have traditionally been expressed as though the mutillid head were prognathous. Since the head actually is hypognathous, I have given directions on the head accordingly, and hope that this practice will be followed in future studies of the nocturnal Mutillidae.

Head shape has been described variously by Schuster, including "evenly semicircular behind the eyes," "temples bulging," "subquadrate," and others. In many cases, species which according to Schuster have the head other than "evenly semicircular" actually have the head outline, dorsal to the eyes, conforming almost exactly to an arc of a circle, rather than as described in one of the above phrases which indicates otherwise. Head shape can be determined precisely by drawing the head outline, in frontal view, with the aid of an ocular grid or camera lucida. On the basis of the height and width of the head above the eyes, one can determine geometrically the center of an arc with those proportions, and trace a true arc with a compass, over the head outline. I have done this with type specimens and have shown elsewhere in this paper that Schuster has imperfectly described head shapes of some species. The interpretation "subquadrate" probably is an illusion, at least sometimes, based on large head size, which results in relatively longer radius curvature, but not the subquadrate condition.

Eye length, as used here, includes measurement of the eye to the margin of the ocular sclerite, which is larger than the black area beneath it.

Ocellar length is the measurement of the greatest dimension of the ocellus.

Ocellocular distance is interpreted here as the shortest distance from the margin of the ocellus, to the margin of the ocular sclerite, but not to the margin of the black eye pigments.

New terminology also is introduced here for the mandibular teeth. Usually the mandibles are tridentate apically, as in Figures 5, 6, and 7. The apical tooth, which is an extension of the posterior margin (ventral margin of Schuster), is termed here the 1°, or primary tooth. The tooth which is an extension of the anterior margin (dorsal margin of Schuster) is termed the 3°, or tertiary tooth. The smallest, often extremely small tooth between, is termed the 2°, or secondary tooth. The mandibular tooth which often is found near the midpoint of the posterior margin and basad of a reduction in mandible width (excision of Schuster), is here considered the basal tooth of the posterior margin (as opposed to the apical teeth).

Thorax is used here as Mickel has used it, to include both the true thorax and the propodeum, and apparently is synonymous with Schuster's term alitrunk.

The pterostigmal cell length is measured from its separation at vein R + M + Sc, to its proximal margin, but not including the vein which encloses it distally. Marginal cell length on the costa is measured on the costal margin between the points where the enclosing veins bend most definitely toward the posterior margin, but none of the posteriorly directed veins is included in the measurement.

The abdominal segments are numbered as in other literature on Mutillidae, with the petiole or morphological second segment considered the first abdominal segment, and the first segment of the gaster considered the second abdominal segment. The length of the second abdominal tergum is measured through the midline of the felt line.

Penis valves, as defined by Michener (1944), are the paired structures between which the membranous endophallus issues apically. The pair is clasped laterally by parapenal lobes of the parameral plates. From the latter, the parameres extend apicad, and the cuspes are parallel to and between these, but are separated from each other basally by the penis valves.

The coarseness of the punctation depends on the diameter and depth of individual punctures in relation to the size of the punctured sclerite. In this paper, the following terms express the degrees of punctation in the order of decreasing coarseness: reticulate, coarse, moderate, small, fine, micropunctate. The latter refers to punctures which are smallest of all, extremely shallow, and do not have vertical walls or sharp margins.

There is a definite need for revision and modernization of mutillid terminology, as well as alteration of the description format, now that our nocturnal mutillid fauna is relatively much better known.

ACKNOWLEDGMENTS

I wish to thank Drs. D Elden Beck and Dorald M. Allred of Brigham Young University who made this study possible. Clive D. Jorgensen, field director for some of the B.Y.U. projects at the test site, was directly responsible for coordinating on-site activities. Mr. Clyde Pritchet, Research Associate, was especially helpful in providing technical assistance. I am also grateful to the following who facilitated the study of type specimens in their care: Drs. Harry Allen and the late Harold J. Grant, Jr., Academy of Natural Sciences at Philadelphia; Dr. K. C. Kim, University of Minnesota; Dr. Karl V. Krombein, U.S. National Museum; Mr. Hugh B. Leech, California Academy of Sciences; Dr. W. R. M. Mason, Canadian National Collection; and Dr. Clarence E. Mickel, Tucson, Arizona. Of special significance was my opportunity to study some type specimens as a part of the Brigham Young University cooperative study.

I acknowledge here the loan and ownership, by the following persons and institutions, of specimens involved in this study. The following abbreviations are used throughout the text: AMNH, American Museum of Natural History; ANSP, Academy of Natural Sciences at Philadelphia; BM, British Museum (Natural History); BYU-AEC, Brigham Young University-Atomic Energy Commission Projects; CAS, California Academy of Sciences; CDA, California Department of Agriculture; CIS, California Insect Survey, University of California at Berkeley; CNC, Canadian National Collection; CU, Cornell University; DAG, D. A. Garner; JZW, J. Z. Warren; LACM, Los Angeles County Museum; OSU, Ohio State University; RMS, R. M. Schuster; TAM, Texas Agricultural and Mechanical College; UA, University of Arizona; UCD, University of California at Davis; UCR, University of California at Riverside; UI, University of Idaho;

UM, University of Minnesota; USNM, United States National Museum; USU, Utah State University; UU, University of Utah, and WEF, William E. Ferguson. All other records not designated by the above initials were taken as part of the Brigham Young University study at the Nevada Test Site.

I am especially grateful to my wife, Stephenie, for her assistance in preparing the manuscript.

SPECIES ACCOUNTS

In the treatments of new species of male mutillids, I have departed from the usual format used for descriptions of the diurnal species. As new taxonomic characters are discovered and other characters are considered to be of little importance, species concepts change. Consequently the nature of the descriptions has changed and will continue to change.

Coloration of the diurnal species often is helpful in identification, but in the nocturnal species it is much more uniform, and therefore much less useful for identification with the unaided eye. Since one must use the microscope to begin identification of the nocturnal forms, even to genus, the taxonomist is aided most by having the key morphological characters mentioned in the diagnosis of each species. In order to keep the diagnosis of males brief yet meaningful, I have included descriptions of certain features of the following: (1) size, (2) mandibles, (3) clypeus, (4) mesosternal tubercles or processes, (5) processes of the coxae and trochanters, and (6) felt lines. The genitalia usually are of great importance taxonomically, but since the description of these structures appears last in each species description, the information is found there easily.

In the lists of type data, a specimen that is not definitely known to be a holotype, as distinguished from lectotype or syntype, is listed thus: holotype (?).

Acrophotopsis eurygnathus Schuster

Acrophotopsis eurygnathus Schuster, 1958. Entomol. Amer., 37(n.s.):10, 68.

Type data. Holotype ♂ Globe, Arizona (CAS). Paratopotypes: 2 ♂ same data as holotype. Paratypes: 44 ♂ (see Schuster, 1958:68).

Discussion. Nineteen specimens were taken in June, July, and August in both can and lighttraps from only two localities at the test site: between Mercury Highway and the Frenchman Flat playa (about 3200 ft), and at the Cane Springs area (4000 ft). Both of these localities are in the Larrea-Franseria biotic communinty (Allred, *et al.*, 1963a). These are the first records of occurrence in the Mojave Desert, and probably represent the northern limit of the species. Other published and unpublished records indicate that *eurygnathus* occurs in the Sonoran Desert of Arizona, but apparently not in the Great Basin Desert.

Dilophotopsis concolor crassa (Viereck), new combination

Odontophotopsis crassus Viereck, 1924. Canadian Entomol., 56:112.

Dilophotopsis concolor utahensis Schuster, 1958. Entomol. Amer., 37(n.s.):87. New synonymy.

Type data. *Odontophotopsis crassus,* holotype ♂ Oliver, British Columbia, Canada (CNC type no. 754). *Dilophotopsis concolor utahensis,* holotype ♂ Delle, Tooele Co., Utah (CU). Paratype ♂ Wadsworth, Storey Co., Nevada (erroneously published as New Mexico, where no such county exists). Although stated in publication that the holotype belongs in the Cornell University collection, it probably is still in the Schuster collection. The new synonymy listed above is based on examination of the holotype of *O. crassus,* which is typical of this Great Basin Desert form, and readily keys to *D. concolor utahensis* in the key by Schuster (1958).

Discussion. One specimen without darkened gaster was taken at study site 6A about 2 mi north Yucca Playa, and 0.6 mi east Mercury Highway (4000 ft).

I have taken this subspecies commonly in all of the Great Basin Desert states. It is significant, therefore, that *crassa* occurs extremely rarely at the test site, and the single collection locality is within the Great Basin Desert portion. *Dilophotopsis concolor paron* (Cameron) is almost equally rare, and apparently does not occur outside of the Mojave Desert portion. These are the distributional relationships one would expect based on collections that have been made to the north and south of the test site.

Dilophotopsis concolor paron (Cameron)

Sphaerophthalma [sic] *paron* Cameron, 1896. Biol. Centrali-Amer., Insecta, Hymenoptera, 2:381.

Dilophotopsis concolor sonorensis Schuster, 1958. Entomol. Amer., 37(n.s.):88.

Dilophotopsis concolor paron Mickel, 1965. Proc. Entomol. Soc. Wash., 67(1):1.

Type data. *Sphaerophthalma paron*, holotype ♂ (BM). *Dilophotopsis concolor sonorensis*, holotype ♂ Gila Bend, Arizona (UM). Paratype ♂ Chiricahua Mts., Arizona (depository unknown).

Discussion. This subspecies is represented at the test site by three specimens taken near porch lights on the CETO[4] laboratory building at Mercury (3800 ft). Apparently it does not even occur at lower elevations in Frenchman Flat. This form with the darkened gaster is characteristic of the Sonoran Desert, and this is the first published record of its occurrence in the Mojave Desert.

Acanthophotopsis falciformis falciformis Schuster

Acanthophotopsis falciformis falciformis Schuster, 1958. Entomol. Amer., 37(n.s.):13, 108.

Type data. Holotype ♂ Palm Springs, California (UM). Paratypes: 2 ♂ Palm Springs, California (one at UM, location of other unknown); 1 ♂ 15 mi E Sombrerete, Mexico (depository unknown).

Discussion. Of the seven specimens taken at the test site, three were attracted to porch lights on the CETO building at Mercury (3800 ft) in August. At locality 5A (3200 ft) in Frenchman Flat, two came to ultraviolet light and one to incandescent light in August, but a fourth specimen was taken from a can pit-trap in June.

No records are known to me for the Great Basin Desert. Earlier published records include only the type series.

Sphaeropthalma (Micromutilla) acontia (Fox)

Photopsis nanus Ashmead, 1896. Trans. Amer. Entomol. Soc., 23:181. Preoccupied.

Mutilla acontius Fox, 1899. Trans. Amer. Entomol. Soc., 25:266.

Mutilla Ashmeadii Fox, 1899. Trans. Amer. Entomol. Soc., 25:289. New name for *P. nanus* Ashmead. New synonymy.

Type data. *Photopsis nanus*, holotype ♂ Tucson, Arizona (USNM type no. 3279). *Mutilla acontius*, holotype ♂ Las Cruces, New Mexico (ANSP type no. 4644).

Discussion. Twenty specimens of this small-sized species were taken in both incandescent and ultraviolet lights in the Mojave Desert portions of the test site in late July and August. Specific localities include only Mercury, Cane Springs, and Rock Valley.

Individuals of this species are among the smallest nocturnal male Mutillidae in North America, averaging 5 mm in length. Consequently they are inconspicuous and usually are not captured unless a special effort is made to catch the smallest mutillids flying among the other insects around a light source. With such effort I collected 17 specimens in one month, whereas other collectors at the test site routinely collected only five in a period of about five years.

New synonymy is based on personal examination of the two type specimens. The genitalia of *acontia* are like those of *S. (Micromutilla) pallida* (Blake), and are unmistakably distinct from those of all other small nocturnal Mutillidae known to me. The cuspis is very short, scarcely extending beyond the tip of the penis valves. This character, coupled with the scarcely excised mandibles, relatively slender petiole, and parameres not apically divergent, facilitates identification of the species regardless of slight differences in size and sculpture.

The only reliable records of the distribution of *acontia* include the type localities of Tucson, Arizona, and Las Cruces, New Mexico. La Cueva, New Mexico (5300 ft) was cited by Melander (1903:318) as a collection locality; however, the altitude probably is too high for *acontia*, and Melander's mention of long pubescence suggests that some other, hairier species was misidentified.

Sphaeropthalma (Micromutilla) becki, new species

Diagnosis. Male: Length 7 mm. Integument of antennae and body testaceous, legs slightly lighter. Mandibles with posterior margin excised to apex, reducing width of apical one-half to ap-

[4]Civil Effects Test Operations of the U.S. Atomic Energy Commission.

proximately one-half of basal width, with subtending tooth angulate and without a deep, rounded notch distally. Clypeal disc longitudinally concave near apical margin, transversely straight, with a pair of blunt, short teeth apically, basally not produced into a carina or tubercle. Mesosternum moderately, shallowly punctate, without tubercles or processes. Coxae and trochanters unarmed. Sternal felt lines subequal in length to those on second tergum. Pygidium polished, very shallowly micropunctate on apical one-fourth.

Description. Head: Integument polished, with outline dorsad of eyes forming an arc of a circle in frontal view; punctures fine, sparse. Measurements in micrometer units: eye length 39, ocellocular distance 17, ocellar length 15. Interocellar area darkened. Mandibles overlap dorsoventrally, anterior margin of distal one-half not twisted dorsad; bearing a distinct carina from base to tertiary apical tooth (Fig. 5). Apical mandibular teeth with 1° tooth basal

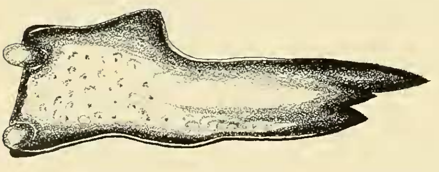

Fig. 5. Mandible of *Sphaeropthalma* (*Micromutilla*) *becki.*

width 1x and length 2x the 3° tooth; 2° tooth basal width ½x the 3° tooth. Clypeal surface polished, with sparse micropunctures bearing long or short simple hairs; apex not impressed below anterior margin of mandibles. Antenna with first flagellar segment short, 0.6x length of second segment. Frontal line and preocellar pit distinct. **Thorax:** Pronotum dorsally and laterally shallowly reticulo-punctate, except polished and shallowly rugose on posterolateral margin. Mesonotal punctures fine, shallow, one puncture width apart, with flat, polished interspaces. Parapsidal lines with posterior one-third impressed. Mesopleuron with anterior impressed area polished, extremely shallowly reticulate, with sparse, simple hairs; posterior raised area reticulate anteriorly, impunctate, polished posteriorly. Propodeum coarsely, shallowly reticulate. Pterostigmal cell 0.38x length of marginal cell on costa. **Abdomen:** Plumose fringes dense only on second tergum apically. First tergum polished, finely punctate medially, moderately punctate laterally, apically 0.56x greatest width of second tergum. First sternum arcuate in cross section, anterior one-half with a mediolongitudinal carina not terminating anteriorly in a distinct tooth. Second tergum polished, finely, sparsely punctate with sparse, brachyplumose, recumbent hairs and long, simple, erect hairs; felt lines 0.4x length of tergum laterally. Second sternum moderately, shallowly, contiguously punctate with sparse, brachyplumose, recumbent hairs and long, simple, erect hairs; anteromedially tumid. **Genitalia:** Parameres arcuate dorsad, laterally straight, glabrous. Cuspis 0.4x free length of paramere, rodlike, with approximately 20 mesally-directed short hairs on mesal surface.

Female. Unknown.

Discussion. *Sphaeropthalma becki* most closely resembles *acontia* in external features, but the apical one-half of the mandibles is more tapered in the latter species. The very short marginal cell in *becki* facilitates distinction from *acontia*, which has the marginal cell approximately equal to the length of the stigma. Furthermore, the genitalia of the two species are very different. In *becki* the cuspis is rodlike and approximately four-tenths the free length of the parameres, but in *acontia* the cuspis scarcely exceeds the length of the penis valves. The holotype was selected for its large size, which best expresses the characteristics of the species. Size ranges from 3 to 7 mm, with the smaller specimens generally having both sculpture and abundance of plumose hairs reduced. In many of the smaller specimens, the frontal line is not visible.

Type data. Holotype ♂ (USNM): Hillside 0.85 mi NNW Mercury, Nye Co., Nevada, at light, W. E. Ferguson. Actual label data: Mercury, Nevada, N.T.S.; BYU-AEC Code MMT; VIII-23-64; ref. no. 1263. Six ♂ paratopotypes same data. Eleven paratopotypes same locality, at light; 1 ♂ VIII-3-64 (no. 1107); 2 ♂ VIII-10-64 (no. 1189); 4 ♂ VIII-20-64 (no. 1232); 4 ♂ VIII-21-64 (no. 1251). Twenty-three paratypes: **CALIFORNIA. Riverside Co.:** 6 mi S Palm Springs, 1 ♂ VI-20-64, at light (WEF). **San Bernardino Co.:** 12 mi N Earp, 2 ♂ V-5-53 (WEF). **NEVADA. Clark Co.:** 8.4 mi SE Indian Spring, 9 ♂ VIII-22-64, at light (WEF). **Nye Co.:** West side Frenchman Flat, 3 ♂ VIII-6-64, at light (no. 1117); 1 ♂ VII-13-61, can trap (no. 25); 2 ♂ VII-19-65, ultraviolet light (nos. 91 and 101); Cane Springs vicinity, 2 ♂ VIII-7-64, at light (no. 1134); Jackass Flats, 3 ♂ VIII-7-62, ultraviolet light (nos. 1086-1088); 5 ♂ VII-20-62, ultraviolet light (nos. 1101-1105). Washoe Co.: 1 mi NW Nixon, 2 ♂ VII-8-61, at light (WEF).

Distribution. This small mutillid is reasonably common at least locally throughout the Sonoran Desert of California, the Mojave Desert, and at least the lower valleys of the western Great Basin Desert. Its abundance is not indicated by most collections because its small size makes it inconspicuous at light-traps, and a special effort must be made to catch individuals as they fly among the larger insects.

Sphaeropthalma (Micromutilla) brachyptera (Schuster)

Photopsis brachyptera Schuster, 1945. Pan-Pacific Entomol., 21:149.

Sphaeropthalma (Micromutilla) yavapai Schuster, 1958. Entomol. Amer., 37(n.s.):19. New synonymy.

Type data. *Photopsis brachyptera*, holotype ♂ Berkeley, California. *Sphaeropthalma yavapai*, holotype ♂ Kirkland, Peeples Valley, Yavapai Co., Arizona (data provided verbally by Schuster). Both specimens are the property of Cornell University, but were still in the Schuster collection in 1959. A paratype of *yavapai* is in the University of Minnesota collection. The unique type of *brachyptera* appears to be an intersex, because the reductions of wings, eyes, and ocelli are comparable reductions in maleness. Such an individual might result from either genetic, nutritional, or other environmental influences. I extracted the genitalia far enough to ascertain that they are identical to those of the normal *yavapai*. The small size of the *brachyptera* holotype (4.7 mm), as in small specimens of other species, also is the cause of reduced sculpture and pubescence. Consequently, this specimen should be compared with larger specimens in the 7-9 mm range as well as with a series in the intermediate range, so that the transition of character expressions can be observed.

Discussion. Thirty-one specimens of this widespread species were collected from the test site at incandescent and ultraviolet light-traps, but not in can pit-traps. Although *brachyptera* occurs in both the Great Basin and Mojave Desert portions of the test site, it was not collected with other species on the gently sloping floors of the valleys. All collections were made during August, which correlates with the time of intensive light-trap collecting rather than with the activity cycle of *brachyptera*. Collection data follow: 3 ♂ hillsides near Mercury (4000-4200 ft); 14 ♂ 0.9 mi W area 12 residences (5500 ft); 1 ♂ Rainier Mesa road (5800 ft); 10 ♂ 3 mi S area 12 residences (6200 ft). The vegetation at these localities included *Quercus gambelii* and *Pinus monophylla*, *Juniperus osteosperma* and *Coleogyne ramosissima*, nearly pure *C. ramosissima*, and "mixed vegetation," but not Larrea-Franseria, and other communities of the valley floors.

Specimens in my collection are from the area including the Coast Ranges of California, east to Mono Lake and the Nevada Test Site, south to the Rio Mayo of Sonora, Mexico, and eastward in Arizona to the Chiricahua Mountains. In specimens from the latter area the gaster, legs, antennae, and pterostigma are considerably darkened. This correlates with the integumental darkening of other species which occur in the same area (see discussion of *S. pallida*). Although *brachyptera* has not been collected from the valley floors at the test site, I have taken it in similar places where *Larrea divaricata* grows at Organ Pipe National Monument in Arizona, and 8 mi NE of Mesa, Arizona.

Sphaeropthalma (Micromutilla) difficilis (Baker), new combination

Photopsis difficilis Baker, 1905. Invert. Pacifica, 1:114-115.

Sphaeropthalma (Micromutilla) maricopella maricopella Schuster, 1958. Entomol. Amer., 37 (n.s.):17. New synonymy.

Sphaeropthalma (Micromutilla) maricopella purisimella Schuster, 1958. Entomol. Amer., 37 (n.s.):17. New synonymy.

Sphaeropthalma (Micromutilla) maricopella castanea Schuster, 1958. Entomol. Amer., 37 (n.s.):17. New synonymy.

Sphaeropthalma (Micromutilla) californiense californiense Schuster, 1958. Entomol. Amer. 37(n.s.):18. New synonymy.

Sphaeropthalma (Micromutilla) californiense fuscatella Schuster, 1958. Entomol. Amer., 37(n.s.):18. New synonymy.

Sphaeropthalma (Micromutilla) quijotoa quijotoa Schuster, 1958. Entomol. Amer., 37(n.s.):18. New synonymy.

Sphaeropthalma (Micromutilla) quijotoa parrasia Schuster, 1958. Entomol. Amer., 37(n.s.):18. New synonymy.

Type data. *Photopsis difficilis*, holotype ♂ Claremont, California (CU); *Sphaeropthalma maricopella maricopella*, holotype ♂ California (CU); paratypes 2 ♂ Hopkins Well, Riverside, California (CIS). *Sphaeropthalma californiense californiense*, holotype ♂ Mt. Diablo, Contra Costa Co., California (CAS); paratypes: ♂ Antioch, Contra Costa Co., California (WEF); ♂ Antelope Is., Davis Co., Utah (CIS). Although type localities were given in Schuster's key for each of the other new taxa (except *fuscatella*) listed above in synonymy, apparently type specimens are not available for study because they have not been designated for those names.

Discussion. Twenty-seven specimens were collected from Mercury, Frenchman and Yucca Flats, and Cane Springs at the test site, but not in the Pinyon-Juniper community on Rainier Mesa. This is a very widespread species which is represented in my collection by specimens from many localities in the Great Basin Desert and throughout the southwest, from coastal California and Mexico east to Las Cruces, New Mexico.

The taxonomic treatment of this species given by Schuster (1958) overlooked the valid name *difficilis*, and stressed differences without equal emphasis on similarities. Consequently, the small, geographically isolated samples which he studied appeared to him distinct enough to bear different names. The unifying characteristics of the many slight morphological and color variants are the convex clypeus, deeply excised mandibles, more or less petiolate condition of the first abdominal segment, and the form of the genitalia. The cuspis is more or less rodlike, slightly bulbous at the apex, and approximately two-thirds the length of the parameres. It bears numerous ventrally-directed long hairs on its entire ventral surface. In addition, the parameres at about mid-length bear at least a few, and usually many long hairs directed mesally and attached to the mesal surface.

I have studied the holotypes of *difficilis* and *californiense californiense*, and paratypes of *maricopella maricopella*. On the basis of a two-week visit with Schuster in 1959 and subsequent correspondence with him, I judge that type specimens have never been designated for the other names listed in synonymy above. Schuster's 1958 key, therefore, provides the only available descriptive information relating to these names. The range of eye sizes given by him clearly indicates that eye size differences form a continuum rather than distinctly different categories. He expressed the distance between the eye and the lateral ocellus as unity, and compared the longest dimension of the eye to that unit of length, with the following results.

Eye Size Range	Taxa
1.6 - 1.9	*californiense californiense* and *c. fuscatella*
2.1 - 2.2	*maricopella maricopella* and *m. castanea*
2.2 - 2.35	*quijotoa quijotoa*
2.5 - 2.6	*quijotoa parrasia*
2.6 - 2.8	*maricopella purisimella*

It is especially significant that the center of the range of eye size in "subspecies" of *maricopella* is not occupied by a subspecies of *maricopella*, but a different "species."

Sphaeropthalma (Micromutilla) macswaini, new species

Diagnosis. Male: Length 7.5 mm. Integument testaceous except head, antennae and legs slightly lighter. Mandible with posterior margin deeply excised, with subtending tooth large, protuberant, rounded (Fig. 6). Clypeal disc longitudinally concave, transversely straight, with margin truncate and carinate apically, and median base not protuberant or carinate. Mesosternum with one or two tiny denticulations on each side of mid-ventral line. Coxae and trochanters unarmed. Sternal felt lines approximately two-thirds length of those on second tergum. Pygidium polished, with extremely shallow micropunctures.

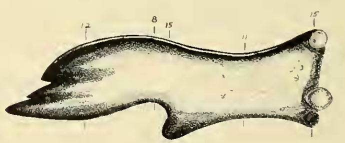

Fig. 6. Mandible of *Sphaeropthalma (Micromutilla) macswaini*. Numbers indicate transverse measurements.

Description. Head: Integument polished, with outline dorsad of eyes inflated dorsolaterally, not forming an arc of a circle in frontal view;

punctures fine (diameters 1-2 units), sparse. Measurements in micrometer units: eye 42, ocell-ocular distance 19, ocellar length 15. Interocellar area slightly darkened. Mandibles overlap dorsoventrally; distal one-half not twisted on its axis; carina of anterior margin well developed, complete, expanded anteriorly at bend; measurements given in Fig. 6. Apical mandibular teeth with 1° tooth basal width 0.6x and length 2x the 3° tooth; 2° tooth basal width 0.25x and length 1x the 3° tooth. Clypeal surface polished, glabrous, impunctate, apex not impressed below anterior margin of mandibles. Thorax: Pronotum dorsally and laterally coarsely, shallowly punctate except rugose on posterolateral margin. Mesonotum finely, shallowly punctate, the punctures approximately four diameters apart, with interspaces polished, glabrous. Parapsidal lines with posterior one-half impressed. Mesopleuron with anterior impressed area finely, shallowly, sparsely punctate, the punctures bearing long and short, brachyplumose hairs; posterior raised area reticulate. Propodeum coarsely reticulate. Pterostigmal cell testaceous, 1.2x length of marginal cell on costa. **Abdomen:** Plumose fringe moderately dense on apex of second tergum only. First tergum polished, minutely and sparsely punctate dorsally, finely punctate laterally, apically 0.52x greatest width of second tergum. First sternum arcuate in cross section, anterior one-half with a mediolongitudinal carina, not terminating in a tooth anteriorly. Second tergum polished, moderately punctate, the punctures one to two diameters apart except contiguous anterolaterally, with short, brachyplumose, recumbent hairs and long simple hairs; felt lines one-half length of tergum laterally. Second sternum moderately, closely punctate, with brachyplumose recumbent hairs and sparse, erect simple hairs, anteromedially tumid. **Genitalia:** Parameres arcuate dorsad and mesad. Cuspis length two-thirds free length of paramere, basally large, gradually tapered to a point apically, arcuate mesad, with mesal surface concave and bearing short, mesally directed hairs.

Female. Unknown.

Discussion. Although the mesosternum of *macswaini* bears tiny denticulations, it is not referable to either *Photomorphus* or *Odontophotopsis* on the basis of the peculiar genitalia. By ignoring the tiny denticulations, *macswaini* keys readily to *Micromutilla*, species group *hyalina*, in Schuster's 1958 key, but does not fit either alternative of couplet three because the petiole is not obviously petiolate, but it has a well-developed clypeus. Since the species of *Micromutilla* have more varied genitalia than *Photomorphus* and *Odontophotopsis*, *macswaini* seems to fit best into *Micromutilla*, at least until more of the undescribed species have been studied and described. Size ranges from about 4 to 9 mm. None of the specimens has well-developed abdominal plumose hairs, even on the second tergum. The cuspis length varies between two-thirds and three-fourths the free length of the paramere. The combination of the distinctive mandibles, with the broad tertiary tooth and the very prominent, rounded tooth on the posterior margin, plus the unusual genitalia, permit quick differentiation of *macswaini* from all of the other described nocturnal mutillids.

Type data. Holotype ♂ (USNM): 2.1 mi NE Mercury, Nye Co., Nevada; VIII-24-64; at light, W. E. Ferguson. Actual label data: Mercury, Nevada, N.T.S.; VIII-24-64; BYU-AEC Code 5CH(T); ref. no. 1277. Fifteen paratypes: **ARIZONA. Yuma Co.:** Dome, 1 ♂ VII-21-24 (CAS). **CALIFORNIA. Imperial Co.:** Kane Springs, 1 ♂ X-3-23 (CAS); 2 ♂ foot of mts. W Salton Sea beach, VII-23-52 (CAS). **Riverside Co.:** Magnesia Canyon, 1 ♂ VII-2-52, 4 ♂ VII-20-52 (UCD); Dead Indian Canyon, 3 ♂ VIII-6-65, at light (WEF); Palm Desert, 1 ♂ IV-11-50 (UI); Palm Springs, 1 ♂ V-29-39 (CAS). **San Bernardino Co.:** Cronise Valley, 1 ♂ IV-29-56 (CIS); 12 mi N Earp, 2 ♂ V-5-53 (WEF). **NEVADA. Nye Co.:** Mercury, code MMT, 1 ♂ VII-10-64, no. 1183, 1 ♂ VIII-21-64, at light, no. 1249.

Distribution. Although large collections of nocturnal Mutillidae have been made in the Great Basin Desert, *macswaini* has not been found there. Collection records cited above suggest that *macswaini* is a hot-desert species, and therefore might not occur outside of the Sonoran and Mojave Deserts. At the test site it occurs as high as 4200 ft.

Sphaeropthalma (Micromutilla) pallida (Blake)

Agama pallida Blake, 1871. Trans. Amer. Entomol. Soc., 3:263.

Sphaeropthalma (Micromutilla) arizonae Schuster, 1958. Entomol. Amer., 37(n.s.):16. New synonymy.

Type data. *Agama pallida*, holotype ♂ Texas (ANSP type 4552). *Sphaeropthalma ari-*

zonae, holotype ♂ Tucson, Arizona, June 5, 1935, Bryant (UM).

Discussion. Seven specimens were taken at the test site in August between approximately 4000 and 5500 ft. Although a large number of mutillids in the small end of the size range were obtained during the limited light collecting at the test site, this species apparently does not occur at lower elevations there, and is not very abundant.

The new synonymy cited above is based on examination of the type specimens and a series of specimens in the University of Minnesota collection. The genitalia of the holotypes are identical as described above in the discussion of *acontia*, but the differences described by Schuster (1958:16) in the key which validated the name *arizonae* simply are expressions of the range of variation that occurs in this species. The holotype *arizonae* is only 3.5 mm in length. With size reduction, sculpture is reduced, and the length of the first flagellar segment becomes slightly reduced in relation to the length of the second segment and pedicel. Coloration also is variable. In the lower elevations (below approximately 4000 ft) the body usually is uniformly testaceous with slightly lighter legs and antennae. However, there is a tendency toward darkening of the second abdominal segment, and this can be detected even at the lower elevations. At 5400 ft in the Chiricahua Mts. of Arizona, the head, thorax, and petiole are ferruginous and the gaster castaneous, but the legs are lighter than the thorax. At higher elevations (5900 ft in the Guadalupe Mts. of New Mexico), the legs and antennae are darkened also, and the humeral angles of the pronotum are darkened in some specimens. Farther east, in Nolan County on the Texas plains at 2000 ft, *pallida* has the coloration of test site specimens. Integumental darkening with increasing altitude, as described here, is not restricted to *pallida*, but is found in most other species which occupy a wide altitudinal belt. Extensive collections will be required to determine more completely the range of *pallida*.

Distribution. Mojave and Sonoran Deserts, east to Texas.

Sphaeropthalma (Micromutilla) parapenalis, new species

Diagnosis. Male: Length 9 mm. Integument entirely ferruginous. Mandibles without posterior margin excised, without a tooth on the posterior, basal margin, more or less parallel-sided from base to base of apical teeth. Clypeal disc longitudinally concave, transversely straight, with a pair of blunt, short teeth apically, basally produced into a prominent tubercle. Mesosternum moderately, shallowly punctate, without tubercles or processes. Coxae and trochanters unarmed. Sternal felt lines reduced to tufts approximately 0.2x the length of tergal felt lines. Pygidium polished, impunctate.

Description. Head: Integument with outline dorsad of eyes forming an arc of a circle in frontal view; punctures moderate, confluent. Measurements in micrometer units: eye length 42, ocellocular distance 22, ocellar length 16. Interocellar area not darkened. Mandibles overlap anteroposteriorly; posterior margin of apical one-half twisted ventrad, anterior margin bearing a distinct carina from base to tertiary apical tooth; measurements given in Fig. 7. Apical mandibular teeth with 1° tooth basal width 1x and length 3x the 3° tooth; 2° tooth basal width 0.75x and length 1.3x the 3° tooth. Clypeal surface polished, with sparse micropunctures bear-

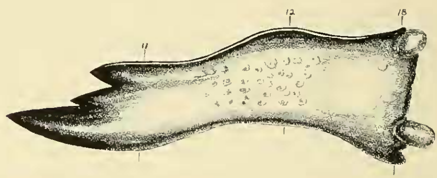

Fig. 7. Mandible of *Sphaeropthalma (Micromutilla) parapenalis* Ferguson. Numbers indicate transverse measurements.

ing short or long hairs; apex not impressed below anterior margin of mandibles. Antenna with first flagellar segment 0.77x the length of second segment. Frontal line and preocellar pit absent. **Thorax:** Pronotum shallowly, coarsely, confluently punctate, except polished and shallowly rugose on posterolateral margin. Mesonotal punctures moderate, shallow, one half puncture width apart, with flat, polished interspaces. Parapsidal lines with posterior one-half impressed. Mesopleuron with anterior impressed area polished, with small, scattered punctures, and micropunctures bearing fine, simple hairs on the interspaces; posterior raised area reticulate, with narrow, polished interspaces anteriorly, impunctate, polished posteriorly, with fine, scattered punctures bearing short, simple hairs. Propodeum coarsely, deeply reticulate. Pterostigmal cell castaneous, 0.82x length of marginal cell on costa. Wing distinctly infuscated apicad in a band posterior to stigma. **Abdomen:** Plumose fringes dense only on second tergum apically. First tergum moderately, confluently punctate throughout, apically 0.49x greatest width of second tergum, first sternum arcuate in cross section, anterior one-half without a mediolongitudinal carina and distinct basal tooth. Second tergum polished, finely, sparsely punctate, with sparse, short, recumbent, and long, erect simple hairs, except more coarsely and closely punctate anterolaterally; subapical margin finely, confluently punctate, with short, simple hairs; felt lines 0.64x length of tergum laterally. Second sternum moderately, shallowly, subconfluently punctate, with long, erect, simple hairs, slightly tumid anteromedially. **Genitalia:** Parameres arcuate dorsad, laterally straight, glabrous. Cuspis 0.38x free length of paramere, rodlike, with approximately 12 mesally-directed short hairs attached to the mesal surface.

Female. Unknown.

Discussion. In Schuster's paper (1958:14), this species was misidentified as *Sphaeropthalma (Micromutilla) juxta* (Blake) to which it keys. The name *juxta* appears again, on page 32 in Schuster's key to the species of the subgenus *Photopsis,* with which it should be associated. The name then should properly read *Sphaeropthalma (Photopsis) juxta* (new combination).

Sphaeropthalma parapenalis is distinct from all other North American nocturnal mutillids in having the parapenal lobes of the parameres impressed, concave, membranous dorsally, and not closely clasping the penis valves laterally. This species usually can be recognized readily without the use of the genital characters by means of the following combination of characters: mandibles with uninterrupted posterior marginal carina, wings with distinct infuscation extending from stigma to posterior margin and more or less distinctly to the apex of the wing. Furthermore, the pubescence of the last two segments of the abdomen is distinctly infuscated, whereas the remaining pubescence is hyaline, and the petiole is more coarsely sculptured than in most species. As is usual in the nocturnal Mutillidae, the smallest specimens have the infuscation and coarseness of sculpture considerably reduced. The distinctness of this species warrants placing it in a group by itself, as Schuster has done. However, since the name *juxta* belongs to another species in another subgenus, the group name *parapenalis* should now be used for the species *parapenalis.*

Type data. Holotype ♂ (CAS): Mt. Diablo, Contra Costa Co., California; VII-11-54; at light, W. E. Ferguson. Paratypes: **ARIZONA. Cochise Co.:** Chiricahua Mts., 1 ♂ VI-27-49 (OSU); Chiricahua Mts., Stewart For. Camp, Cave Creek Canyon, 3 ♂ IX-(13-14)-52 (CAS); Chiricahua Mts., S. W. Research Sta., 2 ♂ IX-1-58, 1 ♂ IX-6-58 (CIS); Chiricahua Mts., Pinery Cn., 1 ♂ VII-30-57 (UA); Chiricahua Mts., 5 mi W Portal, 1 ♂ VIII-5-58 (UCD); 1 ♂ IX-9-59, 1 ♂ VII-2-61, 1 ♂ VII-7-61 (WEF); 3 ♂ VIII-28-57 (UI); 1 ♂ VI-13-58 (WEF); Chiricahua Mts., 3.5 mi W Portal, 3 ♂ VIII-13-52 (CAS); Chiricahua Mts., 15 mi W Portal, 1 ♂ VIII-4-58 (UCD); Portal, 1 ♂ VI-4-59; 1 ♂ VI-23-59 (UCD); 9 mi W Portal, 3 ♂ VII-1-64 (WEF); Huachuca Mts., 1 ♂ VII-36 (CAS); Huachuca Mts., Carr Canyon, 1 ♂ VIII-29-52 (CAS); 8 mi N Bisbee, 1 ♂ VIII-11-52 (CAS); 9 mi S McNeal, 1 ♂ VIII-30-58 (CIS). **Coconino Co.:** Oak Creek Canyon, Midgley Bridge, 2 ♂ VIII-25-52 (CAS). **Graham Co.:** Graham Mts., Noon Creek, 3 ♂ VIII-8-55 (UA, WEF); Thatcher, 2 ♂ VI-18-51, 1 ♂ VI-20-50, 1 ♂ VI-24-50, 1 ♂ VI-26-51 (UCD). **Pima Co.:** Catalina Mts., mile 6, 2 ♂ VII-14-55 (WEF); Santa Catalina Mts., Mt. Lemmon Lodge, 2 ♂ VII-24-52 (UCD). **Santa Cruz Co.:** Santa Rita Mts., Madera Canyon, 1 ♂ VIII-15-40 (CAS); 1 ♂ VII-10-57 (UCD), 1 ♂ VII-14-59 (UA). **Yuma Co.:** San Luis, 1 ♂ VIII-11-40 (CAS). **CALIFORNIA. Alameda Co.:** Berkeley, 1 ♂ VII-14-31 (UCD). **Butte Co.:** Oroville, 1 ♂ VII-13-26 (CDA). **Calaveras Co.:** San Andreas, 1 ♂ VI-16-34 (CAS). **Colusa Co.:** Colusa, 1 ♂ VI-29-59, 1 ♂ VII-1-59, 1 ♂ VII-15-59 (UCD); College City, 1 ♂ VII-9-59 (UCD). **Contra Costa Co.:** 5 mi W Brentwood, 2 ♂ IX-5-58 (WEF); Danville, 1 ♂ VII-8-49, 2 ♂ XII-17-50, 1 ♂ VIII-27-50 (CAS); Martinez, 1 ♂ IV-8-11 (CAS); Mt. Diablo, 1 ♂ VI-11-60, 4 ♂ VII-11-54, 1 ♂ VII-11-56, 2 ♂ VII-19-61, 1 ♂ VII-29-56, 3 ♂ VIII-16-58, 1 ♂ IX-22-56, 4 ♂ IX-24-60, 1 ♂ IX-29-58 (WEF); Pleasant Hill, 1 ♂ VII-19-61, 1 ♂ VII-28-58, 1 ♂ VII-18-52 (WEF); Somersville, 2 ♂ VI-27-56 (WEF); Walnut Creek, 1 ♂ VIII-6-61 (WEF). **Fresno Co.:** Pine Flat Dam, 1 ♂ VIII-5-52 (WEF). **Kern Co.:** Woody, 3 ♂ VII-30-59 (UCD). **Kings Co.:** Lemoore 1 ♂ VIII-11-59 (LACM). **Lake Co.:** Lucerne, 1 ♂ VII-7-51 (CAS); Soda Bay, 3 ♂ VII-25-58, 1 ♂ VII-17-59 (UCD); Lower Lake, 1 ♂ VII-3-59 (UCD). **Los Angeles Co.:** Pasadena, 1 ♂ VIII-4-15 (UCR). **Mendocino Co.:** Ukiah, 1 ♂ XII-22-59 (CDA); Rancheria Creek at Yale Creek, 5 ♂ VII-25-54 (CAS). **Merced Co.:** Dos Palos, 1 ♂ VI-26-57 (WEF). **Mono Co.:** Coleville, 1 ♂ VII-2-48, 1 ♂ VI-29-48, 1 ♂ VII-10-48, 1 ♂ VII-12-48, 2 ♂ VII-16-48, 2 ♂ VII-17-48, 1 ♂ VII-19-48, 1 ♂ VII-28-48, 1 ♂ VII-31-48 (WEF). **Monterey Co.:** Jamesburg, 1 ♂ VII-9-58 (UCD). **Napa Co.:** Mt. George, 1 ♂ no date (WEF). **Sacramento Co.:** Rio Linda, 4 ♂ VI-26-59, 1 ♂ VIII-23-57, 3 ♂ VII-15-55, 2 ♂ VIII-9-55, 4 ♂ VI-29-56, 1 ♂ VII-6-56, 1 ♂ IX-7-56, 2 ♂ VI-28-57, 1 ♂ VII-5-57, 7 ♂ VII-11-57, 8 ♂ VII-19-57, 1 ♂ VII-26-57, 2 ♂ VIII-7-57 (UCD); Carmichael, 1 ♂ VI-23-31, 1 ♂ VI-27-55, 1 ♂ VIII-1-55 (UCD); Fair Oaks, 1 ♂ VI-25-36 (UCD). **San Mateo Co.:** Menlo Park, 1 ♂ I-05 (CAS). **Santa Clara Co.:** San Antonio Val, 2 ♂ VIII-17-49, 1 ♂ VII-30-49 (CIS); New Almaden, 1 ♂ IX-10-64, 1 ♂ VIII-5-64 (WEF). **Shasta Co.:** Redding, 1 ♂ 1958 (UCD). **Solano Co.:** Vacaville, 1 ♂ VII-28-48, 1 ♂ VIII-30-49, 2 ♂ IX-19-52, 1 ♂ VIII-15-53, 1 ♂ VI-9-54, 1 ♂ VII-16-54, 1 ♂ VI-29-56 (UCD). **Sonoma Co.:** Preston, 2 ♂ VII-16-17 (CAS). **Tehema Co.:** Dairyville, 1 ♂ VII-9-56 (UCD); Red Bluff, 3 ♂ VII-9-56, 2 ♂ VII-20-56, 1 ♂ VIII-16-56, 2 ♂ IX-7-56, 1 ♂ IX-21-56 (UCD); Los Molinos, 2 ♂ VII-20-56, 1 ♂ VIII-23-56 (UCD). **Tulare Co.:** Pixley, 1 ♂ VIII-7-59 (LACM). **Yolo Co.:** Davis, 1 ♂ VI-17-59, 1 ♂ VI-22-59, 1 ♂ VII-8-59, 1 ♂ VIII-19-50, 1 ♂ VI-22-54, 1 ♂ VII-17-59, 2 ♂ VIII-4-55, 2 ♂ VIII-10-55, 1 ♂ VIII-5-58, 1 ♂ VIII-12-53, 1 ♂ IX-23-46 (UCD); 4 mi SW Dunnigan, 1 ♂ IV-25-59 (UCD); 4 mi SE Dunnigan, 2 ♂ VII-1-59, 1 ♂ VII-8-59, 2 ♂ VII-28-59 (UCD); 7 mi NW Dunnigan, 3 ♂ VII-1-59, 2 ♂ VII-6-59, 1 ♂ VII-14-59, 4 ♂ VII-12-59, 1 ♂ VII-16-59, 1 ♂ VII-21-59, 1 ♂ VII-28-59, 1 ♂ IX-2-59, 1 ♂ IX-10-59 (UCD); 2 mi SE Dunnigan, 1 ♂ VI-17-59 (UCD); 8 mi NW Winters, 4 ♂ VII-13-59, 1 ♂ VII-28-59, 1 ♂ VIII-5-59, 2 ♂ VIII-28-59, 1 ♂ IX-2-59 (UCD); 9 mi W Zamora, 1 ♂ VII-16-59, 1 ♂ VIII-28-59, 1 ♂ VII-1-59 (UCD); Rumsey, 3 ♂ VII-23-55, 1 ♂ VIII-5-55, 1 ♂ VIII-11-55 (UCD); Esparto, 1 ♂ VII-3-56, 1 ♂ VIII-13-59 (UCD). **IDAHO. Ada Co.:** Boise, 2 ♂ VII-26-53 (CAS). **Cassia Co.:** 5 mi NE Malta, 2 ♂ VII-16- 52 (UI). **OREGON. Umatilla Co.:** Umatilla, 6 ♂ VII-10-58 (WEF); Cold Springs Junction, 4 ♂ VIII-9-60 (WEF). **NEVADA. Eureka Co.:** 27.5 mi W Carlin, 1 ♂ VII-10-59 (CAS); **Nye Co.:** 35 mi NNW Mercury, Nevada Test Site, 1 ♂ VIII-11-64 BYU-AEC code 12M(T), no. 1201; 1 ♂ VIII-11-64 BYU-AEC code 12CC(T), no. 1206; 1 ♂ VIII-5-65 BYU-AEC code ECH(TB), no 1085. **TEXAS. Nolan Co.:** Sweetwater, Texas Exp. Sta., 1 ♂ VIII-3-37 (TAM); 1 ♂ VII-28-37 (WEF). **UTAH. Juab Co.:** Ibapah, Callao Pass, 1 ♂ VIII-3-53 (UU). **Millard Co.:** Delta, 1 ♂ VIII-3-49 (USU). **Weber Co.:** Ogden, 1 ♂ VII-8-59 (CIS). **WASHINGTON. Asotin Co.:** 2 mi S Asotin on river bank, 2 ♂ VII-23-63 (DAG); 1 ♂ VII-23-63 (WEF); 1 ♂ VII-23-62 (JZW). **MEXICO. Chihuahua:** Catarinas, 1 ♂ VII-25-47 (AMNH). **Coahuila:** Cabos, 1 ♂ VIII-21-47 (AMNH). **Durango:** Nombre de Dios, 1 ♂ VIII-6-51 (CIS). **Zacatecas:** 15 km E Sombrerete, 1 ♂ VIII-28-51 (CIS).

Distribution. This is one of the most distinct nocturnal mutillids of North America, morphologically as well as distributionally. In California it occurs through the coastal valleys, the Central Valley, and the coastal as well as Sierran foothills. Farther inland it is found throughout the Great Basin Desert, but apparently only characteristically on the slopes of the ranges rather than in the basins. At the test site this is illustrated by only three specimens captured at three places along the base of Rainier Mesa, 35 miles NNW of Mercury. The dominant vegetation there is *Coleogyne ramosissima*, with sparse *Juniperus osteosperma*. Even large collections at altitudes from 3800 to 4200 ft at the test site did not contain *parapenalis*. In Arizona, *parapenalis* has been found only within the lower edge of the tree belt which usually is associated with the mountains that rise rather abruptly from the desert. Its distribution extends farther east onto the Texas plains at altitudes of at least 2000 ft, and south into Mexico at altitudes up to at least 7500 ft. I have not seen any specimens from the Mojave or Sonoran Deserts.

Sphaeropthalma (Micromutilla) sonora Schuster

Sphaeropthalma (Micromutilla) sonora Schuster, 1958. Entomol. Amer., 37(n.s.):16.

Type data. Holotype ♂ Tucson, Arizona (UM). Paratypes: 2 ♂ Palm Springs, Riverside Co., California (LACM); 1 ♂ Borego, San Diego Co., California (CIS); 2 ♂ Hopkins Well, Riverside Co., California; 1 ♂ Coalinga, Fresno Co., California (CIS); 1 ♂ locality unknown to me (UM).

Discussion. Ninety specimens were collected at the test site from ten different localities of the desert slopes and valleys below the lower limit of the Coleogyne and the Pinyon-Juniper communities, or approximately 4500 ft.

Although *sonora* is locally abundant in the Sonoran and Mojave Deserts, it occurs at least as far north as Fort Churchill and Pyramid

Lake, Nevada, where I have collected it commonly at light. The existence of *sonora* at Yucca Flat thus fits this more extensive, though very imperfectly known, distribution pattern.

Sphaeropthalma (Micromutilla) yumaella Schuster

Sphaeropthalma (Micromutilla) yumaella Schuster, 1958. Entomol. Amer., 37(n.s.):19.

Type data. Holotype ♂ Wellton, Yuma Co., Arizona. The specimen is the property of Cornell University, although it probably still is located in the Schuster collection.

Discussion. Six of ten specimens were collected at incandescent light at Mercury. The other four were taken at incandescent and ultraviolet lights, and from a can pit-trap in study area 5A on the west side of Frenchman Flat in July and August. This species should be present in the Great Basin portion of the test site, since specimens in my collection indicate that the distribution includes the area from Pyramid Lake, Nevada, south into Baja California, Mexico, and east to Portal, Arizona. Representatives of *yumaella* usually are among the smallest nocturnal mutillids, and hence probably were not captured in numbers proportionate to their actual abundance at the test site.

Sphaeropthalma (Photopsis) angulifera Schuster

Sphaeropthalma (Photopsis) angulifera Schuster, 1958. Entomol. Amer., 37(n.s.):32.

Type data. Holotype ♂ Bakersfield, California (CAS). Paratype ♂ Aberdeen, Owen's Valley, Inyo Co., California (ANSP).

Discussion. Seven specimens were collected at the test site from late June to early September within the altitudinal range of 3900 ft near Cane Springs, to 5400 ft at the base of Rainier Mesa. It is surprising that *angulifera* males have not been collected at lower elevations at the test site, because I have taken them at lights in the Mojave Desert near Lancaster and Ivanpah, but never in large numbers.

Sphaeropthalma (Photopsis) blakeii (Fox)

Photopsis Blakeii Fox, 1893. Proc. California Acad. Sci., (Ser. 2), 4:6.

Mutilla ceyx Fox, 1899. Trans Amer. Entomol. Soc., 25:262.

Type data. *Photopsis Blakeii*, lectotype ♂ San Jose del Cabo, Lower California, Mexico (CAS type no. 292). *Mutilla ceyx*, lectotype ♂ Calmali Mines, Lower California, Mexico (ANSP type no. 4653). Syntype ♂ El Paraiso, Lower California, Mexico (ANSP type no. 5054).

Discussion. Only three specimens were taken at light from Mercury, and from locality 5A on the west side of Frenchman Flat. *Sphaeropthalma blakeii* occurs rather commonly in the lower altitude deserts south into Mexico, but I have not collected individuals of this species farther north in the Great Basin Desert. This suggests that *blakeii* is at the limit of its distribution in the Mojave Desert portion of the test site.

The synonymy listed above was based on examination of all three of the cited type specimens, and comparisons of these with a long series of specimens from other localities (Ferguson, 1962:10).

Sphaeropthalma (Photopsis) ferruginea (Blake)

Agama ferruginea Blake, 1879. Trans. Amer. Entomol. Soc., 7:254.

Type data. Holotype ♂ Nevada (ANSP type no. 5615).

Discussion. Four of six specimens were taken at light in August between 5400 and 6100 ft from two localities at the foot of Rainier Mesa on the test site in typical Great Basin Desert vegetation. At the lower site, *Coleogyne ramosissima* was predominant with scattered *Juniperus osteosperma*. A fifth specimen was taken at light in August, approximately 2.3 mi NE of Mercury and 0.2 mi E of Mercury Highway, at 4200 ft. The sixth specimen was taken at light in July from locality 18M.

Specimens in my collection indicate that this species is characteristic of the Great Basin Desert. It also occurs westward to the Coast Ranges, and southward into the mountains of southern California where it occurs in the Pinyon-Juniper and the Oak-Grassland communities.

Sphaeropthalma (Photopsis) helicaon (Fox)

Mutilla helicaon Fox, 1899. Trans. Amer. Entomol. Soc., 25:254.

Photopsis lingulatus Viereck, 1903. Proc. Acad. Nat. Sci. Phila., 54:737. New synonymy.

Sphaeropthalma (Photopsis) carinata Schuster, 1958. Entomol. Amer., 37(n.s.):34. New synonymy.

Sphaeropthalma (Photopsis) helicaon coahuilae Schuster, 1958. Entomol. Amer., 37(n.s.):34. New synonymy.

Sphaeropthalma (Photopsis) helicaon diegueno Schuster, 1958. Entomol. Amer., 37(n.s.):35. New synonymy.

Type data. *Mutilla helicaon,* holotype ♂ Nevada (ANSP type no. 4642). *Photopsis lingulatus,* holotype ♂ La Jolla, San Diego Co., California (ANSP, type not numbered). *Sphaeropthalma carinata,* holotype ♂ Purissima, Baja California, Mexico (property of USNM, unique type not yet deposited by Schuster). *Sphaeropthalma coahuilae*, type material not designated, but presumably from the state of Coahuila, Mexico. *Sphaeropthalma helicaon diegueno*, until June 28, 1959, was represented by a male specimen on loan to Schuster from Cornell University and bearing the following label data: Porter 20; Cornell U., Lot 709, Sub.; Arizona; Specimen B 12 F; Holotype, *Sphaeropthalma helicaon* ssp. *diegueno* Schu. At that time Schuster discovered that this specimen had deeply excised mandibles with a large basal tooth, and therefore did not represent a variation of *helicaon*, nor could it be keyed to *helicaon diegueno* in his key which validated the latter name. Schuster then selected a new holotype male which bears the following label data: S. Carlos, Ariz., 12, 13 May '18, J. Ch. Bradley; Holotype, *Sphaeropthalma helicaon* ssp. *diegueno* Schu. This specimen also belongs to the Cornell University collection, but has not yet been deposited there by Schuster.

Discussion. One specimen was taken at light in June at Mercury. Label data from other specimens in my collection suggest that this species is characteristic of the Mojave and Sonoran Deserts, but not the Great Basin Desert. The rarity of *helicaon* at the test site apparently is indicative of the marginal nature of the environment there for this species.

The new synonymy listed above is based on a preliminary study of this species as a part of a revision of the subgenus *Photopsis*. I have examined all holotype specimens except that of *coahuilae*, which Schuster could not find as of July, 1959. However, specimens from Saltillo, Coahuila, Mexico, are on loan to me from the American Museum of Natural History, and appear to be this dark-headed form. *Sphaeropthalma carinata* is simply an individual which has a scutellar carina formed from the united margins of the punctures on each side of the midline. The expression of punctures and their separating ridges is so variable in a series of a dozen specimens from any given locality, that the variation in the species must exceed even that found in *carinata*. The genitalia probably contain the best taxonomic characters that indicate the unity of this species, and clearly distinguish it from all other known species of nocturnal North American Mutillidae. The parameres are arcuate dorsad, not arcuate mesad, acuminate, glabrous on apical one-half, basal one-half of mesal surface with dense, mesally-directed hairs; cuspis one-half the length of the parameres, rodlike, slightly arcuate, with sparse, long hairs attached to the ventral surface and directed ventromesad. When the genitalia have been extruded from the body, the dense, basal hairs of the parameres, described above, provide instant recognition of the species.

In discussing Schuster's subspecies concepts with him in 1959, he indicated that he studied only one or two specimens which represented each of the names that he used for the taxa listed in synonymy above. Certainly this is not an adequate basis for recognition of subspecies and closely related species in the nocturnal sphaeropthalmine Mutillidae. Schuster (1958: 43) stated of the group *albicincta*, in which he placed *helicaon*, "This is one of the very difficult and polymorphic complexes; the following key is frankly tentative." I consider this to be a good indication that the characters of coloration, eye and ocellar size, puncturation, clypeal convexity, and petiole proportions are so variable and difficult to describe precisely that identification according to Schuster's key is very difficult. Considerable variation is to be expected in a widespread species, but Schuster did not present distributional evidence in support of his taxonomic concepts. I believe it is better to consider that all of the above names are synonymous until enough specimens and distributional data have been massed to make intelligent decisions about possible resurrection of names.

Sphaeropthalma (Photopsis) unicolor (Cresson)

Mutilla unicolor Cresson, 1865. Proc. Entomol. Soc. Phila., 4:389.

Agama mendica Blake, 1871. Trans. Amer. Entomol. Soc., 3:259. New synonymy.

Mutilla auraria Blake, 1879. Trans. Amer. Entomol. Soc., 7:248. New synonymy.

Mutilla Aspasia Blake [not *Sphaerophthalma* (sic) *aspasia* Cameron 1895, Biol. Centrali-Amer., Insecta, Hymenoptera, 2:370.], 1879. Trans. Amer. Entomol. Soc., 7:250. New synonymy.

Mutilla Phaedra Blake, 1879. Trans. Amer. Entomol. Soc., 7:251. New synonymy.

Agama rustica Blake [not *Sphaerophthalma* (sic) *rustica* Cameron, 1895, Biol. Centrali-Amer., Insecta, Hymenoptera, 2:342.], 1879. Trans. Amer. Entomol. Soc., 7:252. Schuster, 1958, Entomol. Amer., 37(n.s.):32. New synonymy.

Photopsis nebulosus Blake, 1886. Trans. Amer. Entomol. Soc., 13:275. New synonymy.

Sphaerophthalma anthophora (sic) Ashmead, 1897. Proc. Southern California Acad. Sci., 1(3):5. New synonymy.

Mutilla monochroa Dalla Torre, 1897. Catalogus Hymenopterorum, 8:63. New name for *Mutilla unicolor* Cresson 1865, not *Myrmosa unicolor* Say, 1824, *in* Keating, Narr. Long's Second Expedition, 2:331.

Dasymutilla sumneriella Cockerell, 1915. Entomol., 48:249. New synonymy.

Sphaeropthalma (Photopsis) rustica ocellaria Schuster, 1958. Entomol. Amer., 37(n.s.):32. New synonymy.

Type data. *Mutilla unicolor*, lectotype ♂ California (ANSP type no. 1887). *Agama mendica*, holotype (?) ♂ Nevada (ANSP type no. 4551). *Mutilla auraria*, holotype (?) ♀ Nevada (ANSP type no. 4573). *Mutilla Aspasia* holotype (?) ♀ Nevada (ANSP type no, 4574). *Mutilla Phaedra*, holotype (?) ♀ Nevada (ANSP type no. 4575). *Agama rustica*, holotype (?) ♂ California (ANSP type no. 4550). *Photopsis nebulosus*, holotype (?) ♂ Nevada (ANSP type no. 4549). *Sphaerophthalma anthophora*, holotype ♂, allotype ♀ Los Angeles, California (USNM types no. 6113). *Dasymutilla sumneriella*, holotype ♀ La Jolla, California (USNM type no. 20409). *Sphaeropthalma rustica ocellaria*, holotype ♂ Berkeley, California (UM).

Characteristics of the named forms. Mutilla *unicolor* is typical of males with the integument entirely light ferruginous; pubescence aureous dorsally and ventrally on the abdomen; plumose fringes prominent only on segment two; eyes, ocelli, and wings normal. Females of this form have been identified as *aspasia* or *phaedra*.

Photopsis nebulosus is the form with the integument light ferruginous, except the femora slightly infuscated; pubescence hyaline except slightly aureous dorsally; eyes and ocelli normal. This was synonymized with *auraria* females on the basis of rearing the two sexes from cells of *Diadasia* (Linsley and MacSwain, 1952; Ferguson, 1962).

Agama rustica represents males with the integument ferruginous, except the thorax laterally; antennae, legs, and petiole castaneous to black; pubescence aureous; eyes, ocelli, and wings normal. Females usually were identified as *auraria*. Schuster (1958) used the name incorrectly for males with the coloration of *rustica*, but which have the abnormal condition of brachyptery and small eyes and ocelli. The type specimen is normal in these respects.

Sphaeropthalma rustica ocellaria (Schuster, 1958:32) is the name proposed in error for normal specimens like the type of *rustica*.

Agama mendica has the integument entirely castaneous to black, and pubescence entirely hyaline.

Sphaerophthalma anthophora males have the integument ferruginous, except the flagellum, legs, and thorax laterally black, with pubescence reddish aureous. Females have the integument translucent ferruginous, except the thorax laterally and the legs black. Pubescence is reddish.

Dasymutilla sumneriella is the same as *anthophora* females, and was synonymized by Krombein (1951).

Discussion. The long synonymy above is the result of study of well over one thousand specimens of this species, including all of the type specimens. *Sphaeropthalma unicolor* occurs from sea level on the Pacific Coast, eastward into the Mojave and Great Basin Deserts to Utah and New Mexico. In the north-south direction, it extends from Washington and Idaho into the coastal areas and middle altitudes of the northern mountains of Baja California. I have not seen specimens from the Sonoran Desert. The synonymy well represents the variability in this widespread species which occupies so many ecologically different yet intergrading environments.

At the test site, *unicolor* apparently is one of the most abundant nocturnal Mutillidae, ranking equally with *Odontophotopsis microdonta* Ferguson. It occurs from the valley floors to the Pinyon-Juniper and Artemisia communities at well over 7000 ft. At approximately the lower limit of the junipers the ferruginous-colored valley form is replaced by the melanistic one, which is found only at the higher altitudes, above 5500 ft. Since the two forms apparently are not sympatric any place within their distribution, yet appear to have continuous distributions, it appears to me that one form may be gradually replacing the other. The more favorable conditions of the desert valleys and the Central Valley of California, as well as the Columbia and Snake River Valleys, certainly must permit more generations per year. Hence, if the ancestral form of *unicolor* were melanistic like the Great Basin form, and mutations for lighter coloration occurred in the lower altitude populations, the more rapid genetic turn-over there would have permitted rapid spread of lighter coloration in the areas of favorable climate. I have traced the limits of the two major color forms from southern Idaho, along the east flank of the Sierra Nevada, and along the basins and ranges where the Mojave and Great Basin Deserts interdigitate. These records show the same altitudinal relationship of the two male color forms, without the distributional overlaps which are characteristic of different species.

Collections at the test site include 76 females which were found in can pit-traps, while only four males were found in the same traps. During a brief period of intensive light-trapping in August, 1964, 36 of the lighter-colored males and 13 of the melanistic males were collected.

Sphaeropthalma (Photopsioides) amphion (Fox)

Mutilla amphion Fox, 1899. Trans. Entomol. Soc. Amer., 25:263.

Photopsis abstrusa Baker, 1905. Invert. Pacifica, 1:113. New synonymy.

Photopsis nudatus Baker, 1905. Invert. Pacifica, 1:114.

Type data. *Mutilla amphion*, holotype (?) ♂ Nevada (ANSP type no. 4654). *Photopsis abstrusa*, holotype (?) ♂ Claremont, California (CU). *Photopsis nudatus*, holotype (?) ♂ Claremont, California (CU).

Discussion. Ten males of *amphion* were collected at the test site. In all of the collections made from autumn, 1959, to August 1, 1964, only one specimen was taken. This was found on the ridge which separates Frenchman and Yucca Flats, within a box-type live-catch trap used for mammals. Through intensive light-trapping in August, 1964, eight additional specimens were collected from the hillsides around Mercury, study area 5A on the west side of Frenchman Flat, and the area of *Quercus gambelii* and *Pinus monophylla* at the base of Rainier Mesa. One additional specimen was taken at ultraviolet light in the same general area on August 5, 1965.

The new synonymy listed above is based upon study of all of the type specimens and a series of more than sixty others. Schuster (1958: 38) synonymized *nudatus* with *amphion*, but considered *abstrusa* as a subspecies of *amphion*. This is absurd because the type specimens of *nudatus* and *abstrusa* were collected at the same locality. Schuster separated the two subspecies on the basis of proportions of marginal cell length and stigma length, depression of the clypeus, and body size. These factors are variable even within given localities, and size is independent of the other two variables. Figure 8 shows the variability in the proportions of stigma length compared with marginal cell length on

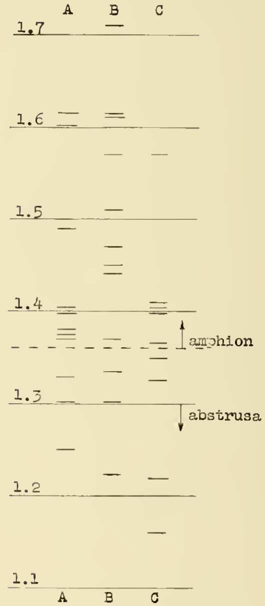

Fig. 8. *Sphaeropthalma (Photopsioides) amphion* (Fox) stigma length compared with marginal cell length (unity). Columns represent measurements of all individuals in population samples from: A, Nevada Test Site; B, New Almaden, Santa Clara Co., Calif.; C, Coleville, Mono Co., Calif. Arrows indicate limits of subspecies proposed by Schuster (1958).

the costa (expressed as unity) in a series of eight, ten, and twelve specimens, the total numbers taken from three widely separated localities. I believe that this graphic evidence establishes the former arbitrary and invalid division of this species into two subspecies.

Odontophotopsis (Odontophotopsis) armata Schuster

Odontophotopsis (Odontophotopsis) armata Schuster, 1958. Entomol. Amer., 37(n.s.):60.

Discussion. Fifty-two specimens were collected at incandescent light on the hillsides near Mercury and at Cane Springs. Apparently this is a Mojave Desert species and occurs on the valley slopes, but not in the bottoms of the valleys or as high as the Pinyon-Juniper community. This is the first locality recorded for this species since Schuster validated the name in a key, without designating a type specimen or type locality. The identification of this species, therefore, is based entirely upon Schuster's key.

Odontophotopsis (Odontophotopsis) clypeata Schuster

Odontophotopsis (Odontophotopsis) clypeatus Schuster, 1958. Entomol. Amer., 37(n.s.):59.

Type data. Holotype ♂ Tucson, Arizona (UM). Paratype ♂ Arizona (UM).

Discussion. Of fourteen specimens captured at the test site, seven were found in can pit-traps in study areas 5A and 5E on the west side of Frenchman Flat in July, August, and September, 1961. In the same general area, three specimens were collected at ultraviolet light and two at a gasoline lantern during August, 1964. Although much light-trapping was done at Mercury and the nearby hillside, only one specimen was taken there. Only one specimen (ref. no. 73) is from Yucca Flat, where it came to light. Specimens from can pit-traps were preserved in alcohol before being pinned; therefore, the lighter parts of the integument are darkened more than in specimens which were pinned while fresh and allowed to dry.

Little can be said about the distribution of *clypeata* at the test site except that it occupies the Mojave Desert portion, although one specimen was taken in Yucca Flat. It seems to be much less abundant than *O. microdonta* Ferguson, which is its closest relative (see discussion of *microdonta*). Additional material was examined from the following localities: St. George, Washington Co., Utah; 8 mi NE Mesa, Maricopa Co., Arizona; Organ Pipe National Monument, Pima Co., Arizona; and 6 mi S Palm Springs, Riverside Co., California.

Odontophotopsis (Odontophotopsis) cookii Baker

Odontophotopsis cookii Baker, 1905. Invert. Pacifica, 1:93.

Type data. Holotype ♂ Claremont, California (CU).

Discussion. Twelve specimens were collected from the test site. One of these came to light near Cane Springs (4000 ft), but all others were collected at incandescent or ultraviolet light along the base of Rainier Mesa. Those three areas contained *Coleogyne ramosissima; Juniperus osteosperma* and *Coleogyne ramosissima;* and *Quercus gambelii* and *Pinus monophylla*. Identification of this species was based on examination of the type specimen and comparison of the test site specimens with a large series from California. The test site specimens are different from all others in having the mesosternal tubercles reduced considerably, so that in some specimens they are inconspicuous. Otherwise, the key characteristics, form of the mandibles, genitalia, and sculpture appear to be identical in specimens from the test site and from California. When collections in intermediate localities can be made, it should be possible to determine whether or not the test site specimens should be given a different name.

Odontophotopsis (Odontophotopsis) inconspicua inconspicua (Blake)

Photopsis inconspicuus Blake, 1886. Trans. Amer. Entomol. Soc., 13:272.

Type data. Holotype (?) ♂ California (ANSP type no. 4610).

Discussion. Twenty-seven specimens were collected from the hills surrounding Mercury, the *Atriplex* area near the southwest edge of the playa in Frenchman Flat, Cane Springs, and in the lowest edge of the juniper belt at the base of Rainier Mesa. Although *O. inconspicua inconspicua* occurs in both the Mojave and Great Basin Desert portions of the test site, it apparently does not occur as high as the *Artemisia tridentata* association on the top of Rainier Mesa. This species occurs commonly in the Central Valley of California, and south into the Colorado

Desert of California, at least as far as Indio in Riverside County.

Odontophotopsis (Odontophotopsis) microdonta, new species

Diagnosis. Male: Length 9 mm. Integument of head, thorax, and petiole ferruginous; gaster castaneous; legs and antennae testaceous. Mandibles with posterior margin deeply excised, with subtending tooth large, protuberant, rounded. Clypeal disc longitudinally concave, transversely straight, with a pair of blunt, apical teeth, basally not protuberant or carinate. Mesosternal tubercles scarcely differentiated from puncture margins. Coxae and trochanters unarmed. Sternal felt lines approximately one-third length of those on second tergum. Pygidium polished, impunctate, apical fringe absent.

Description. Head: Integument polished, with outline dorsad of eyes forming an arc of a circle in frontal view; punctures fine (diameter 2 units), sparse. Measurements: eye length 47 units, ocellocular distance 16 units, ocellar length 16 units. Interocellar area darkened. Mandibles overlap dorsoventrally; anterior margin of distal one-half slightly twisted dorsad, and bearing a distinct carina from base to tertiary apical tooth. Apical mandibular teeth with 1° tooth basal width 1x and length 2x the 3° tooth; 2° tooth basal width Ix and length 1x the 3° tooth. Clypeal surface polished, with sparse micropunctures bearing long or short, simple hairs; apex not impressed below anterior margin of mandibles. Antenna with first flagellar segment 0.77x the length of second segment. Frontal line and preocellar pit distinct. **Thorax:** Pronotum dorsally and laterally coarsely, shallowly punctate except rugose on posterolateral margin. Mesonotum moderately, shallowly punctate (puncture widths 4 units) with flattened, narrow interspaces polished. Parapsidal lines entirely impressed. Mesopleuron with anterior impressed area moderately to finely punctate, sparsely plumose-hairy; posterior raised area moderately punctate to reticulate. Propodeum coarsely reticulate. Pterostigmal cell testaceous, 1.05x length of marginal cell on costa. **Abdomen:** Plumose fringes dense on segments two and three apically. First tergum moderately, closely punctate, apically 0.5x greatest width of second tergum. First sternum arcuate in cross section, with a mediolongitudinal carina on the anterior two-thirds, terminating anteriorly in a prominent blunt tooth. Second tergum polished, finely, sparsely punctate, the punctures two to three diameters apart, except anterolaterally more closely, coarsely punctate, with brachyplumose, recumbent hairs and erect simple hairs; felt lines one-half length of tergum laterally. Second sternum moderately, shallowly, contiguously punctate, with brachyplumose, recumbent hairs and erect simple hairs; anteromedially tumid. **Genitalia:** Parameres arcuate dorsad, laterally straight, glabrous. Cuspis length one-half free length of paramere, rodlike, flattened, with approximately twenty mesally-directed short hairs on mesal surface.

Female. Unknown. In spite of can pit-trap and light-trap records, it has not been possible to correlate the sexes of this species.

Discussion. *Odontophotopsis microdonta* is most closely related to *O. clypeata* Schuster except for the reduction of the mesosternal tubercles, but should key out to the latter species. The holotype was selected because its tubercles are well developed for this species. Even when the tubercles are absent, *microdonta* can be recognized as belonging to *Odontophotopsis* because of the typical genitalia (described above), with the cuspis about one-half the free length of the parameres, and the abundance of brachyplumose body hairs. The mesosternal tubercles, which are key generic characteristics, normally are so small that they can be easily overlooked. Hence, with the normal condition minimal, slight variation results in absence or in a relative prominence of the tubercles. Since this species very closely resembles *clypeata*, specimens with relatively distinct mesosternal tubercles may be mistaken for that species. However, the tubercles of *clypeata* are larger and are in a different place. In *microdonta* the tubercles are approximately two puncture widths anterior to the mesocoxae, but in *clypeata* they are approximately two puncture widths farther anterior. Punctures used as the basis for measurement lie lateral to the tubercles. An additional complication in identification involves variation in pigmentation of the gaster. Dark specimens are not a problem, but some specimens have the dark integumental pigment reduced to the vicinity of the felt lines, and occasionally specimens lack dark pigment entirely. In this case identification may be difficult, depending on the prominence of the mesosternal tubercles. Only a few specimens of *microdonta* have been observed with some pygidial fringe hairs, whereas specimens of *clypeata* characteristically have the fringe well-developed. In *clypeata* this character is variable, probably owing to abrasion and heredity, but there is nearly always evidence of at least a few fringe hairs. *Odontophotopsis microdonta* differs further from *clypeata* by the slightly twisted mandibles mentioned in the description. The difference between twisted and untwisted is very subtle in this case, and difficult to describe and ascertain in individuals. However, in series of the two species separated on the basis of other characteristics, the distinction is more apparent. Furthermore, *clypeata* tends to have the medial base of the clypeus slightly more produced at its juncture with the frons than in *microdonta*.

Type data. Holotype ♂ (USNM): 5 mi NNW Mercury, Nye Co., Nevada (USGS Specter Range Quadrangle, 1 mi from Mercury Highway, at 3400 ft), ultraviolet light, W. E. Ferguson. Actual label data: Mercury, Nevada, N. T.S.; BYU-AEC Code 5M(TB); VIII-25-64; ref. no. 1298. Seven male paratopotypes same data. Seventy-eight paratypes: west side Frenchman Flat, 9 ♂ VIII-6-64, at light (code 5MT, no. 1115); 8 ♂ VIII-29-64, ultraviolet light (code 5AT, no. 1316); Cane Springs vicinity, 16 ♂ VIII-7-64 (codes CBT, CMT, nos. 1119, 1133); Mercury, CETO Bldg., 26 ♂ VIII-(10, 20, 21, 23)-64, at light (code MMT, nos. 1186, 1237, 1244, 1267); 2.2 mi NNE Mercury, 3 ♂ VIII-24-64, at light (code 5 CHT, no. 1279); west side Yucca Flat, 2 ♂ VIII-14-64, at light (code 1BB25T).

Additional material. The following specimens from the test site are not included in the type series because they have the normally light portions of the integument darkened, and the pubescence is matted owing to long preservation in alcohol before being pinned. Twenty-six males from can pit-traps: west side Frenchman Flat, 16 ♂ VII-11 to IX-19-61 (codes 5A and 5E); Study site CP, 5 ♂ VIII-28-59; Cane Springs, 2 ♂ IX-2-59; 1 ♂ VII-4-61. West side Yucca Flat, 1 ♂ VI-22-60 (code 1BF25C, no. 608). The following material in my collection from outside the test site was examined for comparison. **CALIFORNIA. Riverside Co.:** 25 mi S Ivanpah, 2 ♂ X-13-58, at light. **NEVADA. Lyon Co.:** Fort Churchill, 1 ♂ VII-9-61, at light.

Distribution. On the test site, as elsewhere, this species appears to be common in parts of the Mojave and Great Basin Deserts. The only known distribution is reported above.

Odontophotopsis (Odontophotopsis) *obliqua* Viereck

Odontophotopsis obliquus Viereck, 1925. Canadian Entomol. 56:112.

Odontophotopsis (Odontophotopsis) mellicausa [sic] *obliquus* Schuster, 1958. Entomol. Amer., 37(n.s.):59.

Type data. Holotype ♂ Vernon, British Columbia, Canada (CNC type no. 753).

Discussion. Thirty-two specimens were collected in the hills surrounding Mercury, at several sites in Frenchman Flat, at Cane Springs, several places in Yucca Flat, and on the higher alluvial slopes at the base of Rainier Mesa. This is essentially the same distribution at the test site as for *O. inconspicua inconspicua*. However, eleven *obliqua* were taken from can pit-traps in study area 1B in Yucca Flat, whereas no specimens of *inconspicua* were taken from those traps.

The type specimen of this species cannot be identified correctly in the most recent key to species of *Odontophotopsis* because Schuster (1958:57) indicates in couplet 4 that *obliqua* has the "Head subtruncate behind, somewhat transversely rectangular, not evenly, suddenly narrowed behind eyes, the short temples not inflated. . . ." The head of the holotype is definitely not subtruncate behind nor somewhat transversely rectangular. When the head outline was drawn on graph paper by means of an ocular grid, it coincided perfectly with an arc drawn with a compass. Consequently, the holotype better fits the alternative in couplet 4: "Head evenly semicircular in dorsal outline, behind the eyes, the temples not at all developed. . . ." The holotype does not fit the descriptions of any of the taxa which key from this alternative, however.

Odontophotopsis obliqua has mandibles, clypeus, mesosternal tubercles, and felt lines very much like other members of Schuster's *mellicausa* complex, but it has several distinguishing characteristics. The pygidium usually appears dull, as though greasy, and has more or less distinct punctures on approximately the apical one-third. Sometimes a weak pygidial fringe emanates from the more apical of these punctures. Furthermore, the marginal cell is approximately one-third longer than the stigma. This differentiates *obliqua* from some, but not all of the *mellicausa* complex.

Examination of the holotype and specimens on loan and in my personal collection indicates that *obliqua* occurs as far north as Vernon, British Columbia, Canada, into the Columbia and Snake River Valleys, throughout the valleys of the Great Basin Desert, the valleys and foothills of California, and south into Baja California. Although at the test site this species occurs in the Mojave Desert portion, further collections and studies will be required to determine its distribution in the Mojave and Sonoran Deserts.

Odontophotopsis (Odontophotopsis) quadrispinosa Schuster

Odontophotopsis (Odontophotopsis) quadrispinosa Schuster, 1958. Entomol. Amer., 37(n.s.): 51.

Type data. Holotype ♂ Baja California (apparently in the Schuster collection). Paratype ♂ locality unknown to me (UM).

Discussion. Thirty-three specimens of *quadrispinosa* were attracted to incandescent and ultraviolet lights in the environs of Mercury, the west side of Frenchman Flat, at the base of Rainier Mesa in a stand of *Coleogyne ramosissima*, and in the *Pinus monophylla* and *Artemisia tridentata* on the top of Rainier Mesa. One specimen was caught in a box-type mammal trap on the ridge between Frenchman and Yucca Flats, and another was taken from a Berlese funnel in which the roots and root crown of *Coleogyne ramosissima* had been placed for extraction of arthropods. Evidently the mutillid had been hiding during the day in abandoned insect burrows in the plant.

The distribution of *quadrispinosa* has been unknown since only the vague type locality "Baja California, Mexico" was cited by Schuster. Specimens in my collection were taken at the following localities: 1 mi NW Nixon, Washoe Co., Nevada; 6 mi S Palm Springs, Riverside Co., California; and 12 mi N Earp, San Bernardino Co., California. These records, those from the test site, and the type locality suggest that this species of small size may have as great an altitudinal distribution as any of our nocturnal Mutillidae. Furthermore, on the basis of these distributional data, one can expect a much wider distribution than is presently known.

Identification of this species is based on brief examination of a specimen of *quadrispinosa* obtained from Schuster in July, 1959. I believe that the specimen described in Schuster's key, which validates the name *quadrispinosa*, is abnormal in having small wing cells. None of the specimens which I recognize as *quadrispinosa* has such venation. These have the general facies of *Sphaeropthalma (Micromutilla) difficilis*, but have the very obscure mesosternal tubercles about four times farther apart than the tubercles are long. The genitalia are somewhat like those of *difficilis* in having the parameres the same shape, but they lack the mesally directed long hairs at midlength. The cuspis also is about two-thirds the length of the parameres, but has the mesally directed hairs short, and lacks the slight enlargement at the apex.

Odontophotopsis (Odontophotopsis) serca Viereck

Odontophotopsis sercus Viereck, 1904. Trans. Amer. Entomol. Soc., 20:87.

Type data. Holotype ♂ Lower California, Mexico (ANSP type no. 4979).

Discussion. Fifteen specimens were collected at incandescent light on the hillsides above Mercury, and one was found in a box-type trap used for collecting mammals. Apparently this species does not occupy the lower portions of the test site, and it does not exist in the Great Basin portion. A small number of additional specimens in my collection indicate that *serca* has a continuous distribution from the test site through the Mojave and Colorado Deserts into Lower California.

Identification of these specimens is based on examination of the holotype and comparison of the test site series with the other specimens mentioned above. There is enough variability in the mediobasal portion of the clypeus to occasionally make it difficult to distinguish members of this species from those of *armata*. There is a tendency toward development of a slight secondary mesosternal tubercle on the mesal side of the primary one. Sometimes this is unilateral. Apparently the area where a sternal felt line should be never develops excess plumose hairs in the absence of micropunctures, as sometimes happens in occasional specimens of *armata*.

Odontophotopsis (Odontophotopsis) setifera Schuster

Odontophotopsis (Odontophotopsis) setifera Schuster, 1952. Bull. Brooklyn Entomol. Soc., 47(2):47.

Type data. Holotype ♂ Palms to Pines Highway, Riverside Co., California, 1000 ft elevation (RMS). Paratype ♂ Ehrenberg, Arizona (UM).

Discussion. One specimen was collected at the test site in study site 5E on July 27, 1960. This section of Frenchman Flat is within the Larrea-Franseria community (Allred, *et al.*, 1963a:Fig. 44), although vegetation at the specific collection site of this specimen is predominantly *Lycium pallidum.*

Two specimens in the San Jose State College collection are from nearby Death Valley, and provide additional information concerning the occurrence of *setifera* as indicated by the label data: Stovepipe Wells, Death Valley, California; May 31, 1952. In spite of intensive collecting of nocturnal Mutillidae in recent years in the arid western states, *setifera* appears to be rare, and apparently does not occur in the Great Basin Desert. Hence, it probably is near the northern limits of its range in Frenchman Flat (3080 ft) and at Stovepipe Wells (sea level), and probably does not occur even in the lower parts of Yucca Flat (3914 ft).

Odontophotopsis (Periphotopsis) mamata Schuster

Odontophotopsis (Periphotopsis) mamata Schuster, 1958. Entomol. Amer., 37(n.s.):60.

Type data. Holotype ♂ Arizona (UM). Paratypes: Globe, San Carlos, and Roosevelt Lake, Gila Co.; Phoenix, Maricopa Co.; Tucson, Pima Co., Arizona; Rosamond, Kern Co.; Mecca, Palm Springs, and Pinon Flats, Riverside Co., California (UM).

One hundred specimens were collected at the test site, making *mamata* one of the three most abundant species known only from the male sex. It occurred most abundantly in the *Atriplex* and *Larrea* associations at study areas 5A and 5E, respectively. It was caught there regularly in can traps in July and August, and at incandescent and ultraviolet light-traps during intensive collecting in August, 1964. At the Command Post (CP) study site, on the ridge between Frenchman Flat and Yucca Flat, twelve were collected from box-type Allred mammal traps on August 28, 1959, but at no other time. Eight came from one trap (CPA3L) and four from another (CP1L). The unusual concentration of males in one trap suggests that they might have been lured in by the odor of a virgin female. However, no females were recorded from either trap on that date. One specimen was taken from can traps in study area 1B, in Yucca Valley. Additional light trap collections were made in the vicinity of Cane Springs, the hillside above Mercury, and in Jackass Valley.

The distribution of *mamata* at the test site confirms unpublished label data from my collection which indicate that it is not a Great Basin Desert species. Rather, it is common in the Mojave and Sonoran Deserts.

Dasymutilla gloriosa (Saussure)

Mutilla gloriosa Saussure, 1867. Ann. Soc. Entomol. France, (Ser. 4) 7:359.

Mutilla tecta Cresson, 1875. Trans. Amer. Entomol. Soc., 5:119.

Dasymutilla reperticia Mickel, 1928. Bull. U.S. Nat. Mus., 143:287.

Type data. *Mutilla gloriosa* ♀ and *D. reperticia* ♂, refer to Mickel (1928:242, 288). *Mutilla tecta*, type ♀ California (ANSP).

Discussion. Only three females of this distinctive species were collected at the test site in July, August, and September. One specimen came from a can pit-trap at Cane Springs, a second was taken by hand in Jackass Flats, and the third from an unknown locality.

The distribution of *gloriosa* is well documented, and indicates that its range is rather closely coincident with that of the creosote bush, *Larrea divaricata.* Since the northern limit of *Larrea* is at the test site and *gloriosa* is rare there, it likely will not be found in the Great Basin Desert portion of the test site.

Dasymutilla paenulata Mickel

Dasymutilla paenulata Mickel, 1928. Bull. U.S. Nat. Mus., 143:206.

Type data. Holotype ♀ Phoenix, Arizona (CU type no. 764.1). Paratype ♀ Phoenix, Arizona.

Discussion. One specimen of this apparently rare species was found in a can pit-trap at locality TA, 4.4 mi S Tippipah Spring, in July. The specific vegetation there is *Artemisia tridentata*, although Allred, *et al.* (1963b) consider the general area to be part of the Coleogyne community. Little can be said about the occurrence of *paenulata* at the test site as it relates to the distribution of the species, because this is only the third specimen recorded in the literature.

Identification was made by means of the key and description by Mickel (1928, 1936) without examination of type material.

Dasymutilla satanas Mickel

Dasymutilla satanas Mickel, 1928. Bull. U.S. Nat. Mus., 143:239. ♀.

Dasymutilla mimula Mickel, 1928. Bull. U.S. Nat. Mus., 143:255. ♂.

Type data. Refer to Mickel (1928).

Discussion. Twenty-four females were collected from Jackass, Frenchman, and Yucca Flats from early July to late September. All except two were found in can pit-traps. One of these two was picked up on the desert by hand, but the other apparently was attracted by ultraviolet light and fell into a water trap on the ground (Fig. 3).

Only one male *satanas* was collected during the entire study, at locality 5A in Frenchman Flat, on July 6. The method of capture was not recorded.

The distribution of *D. satanas* extends from deep in the Sonoran Desert of Baja California and Sonora, Mexico, apparently to about 4400 ft in the higher desert valleys such as Yucca Flat, along the northern margin of the Mojave Desert.

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